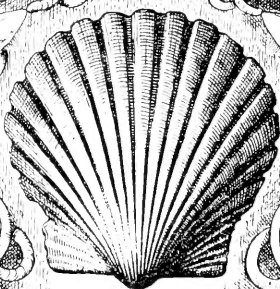


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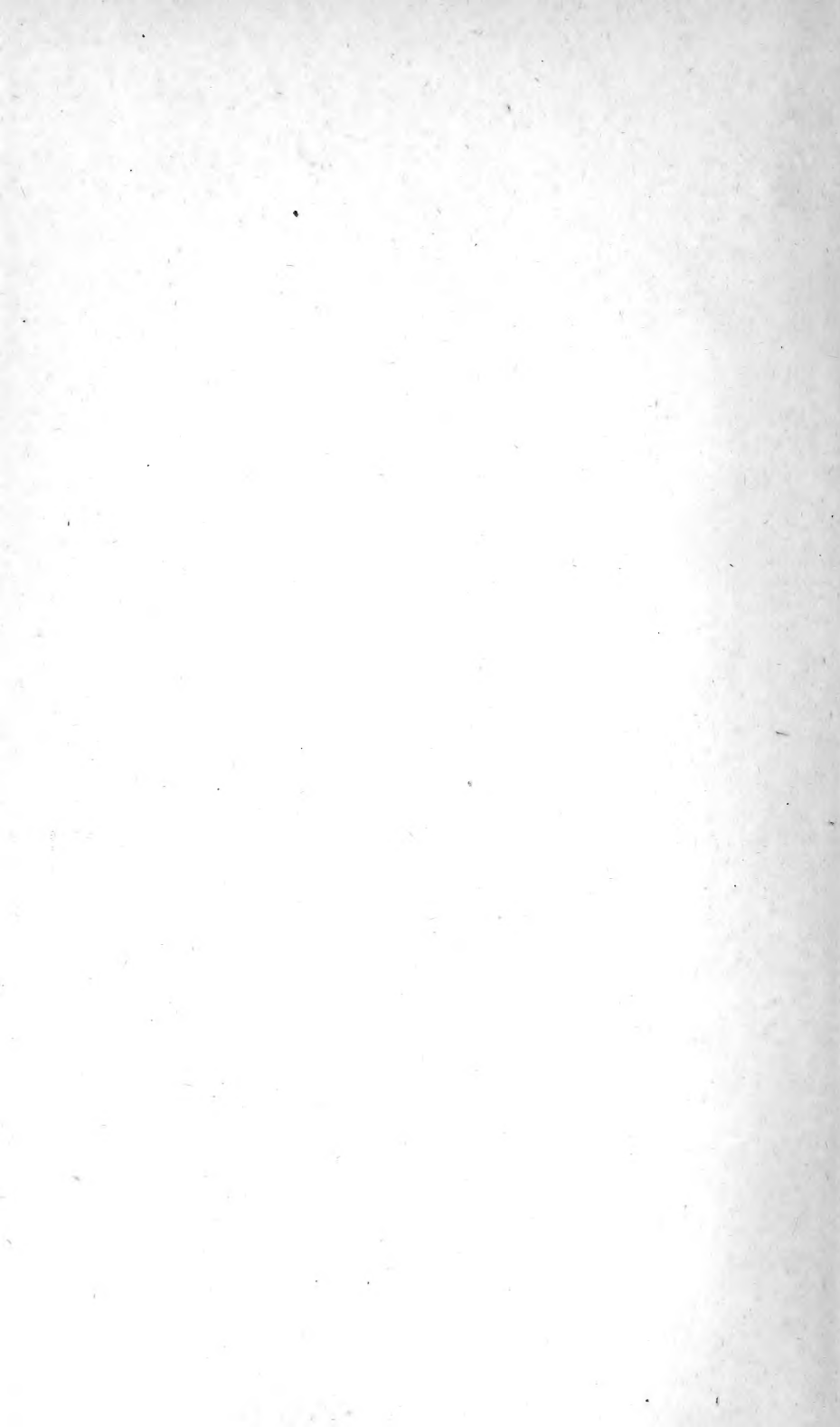


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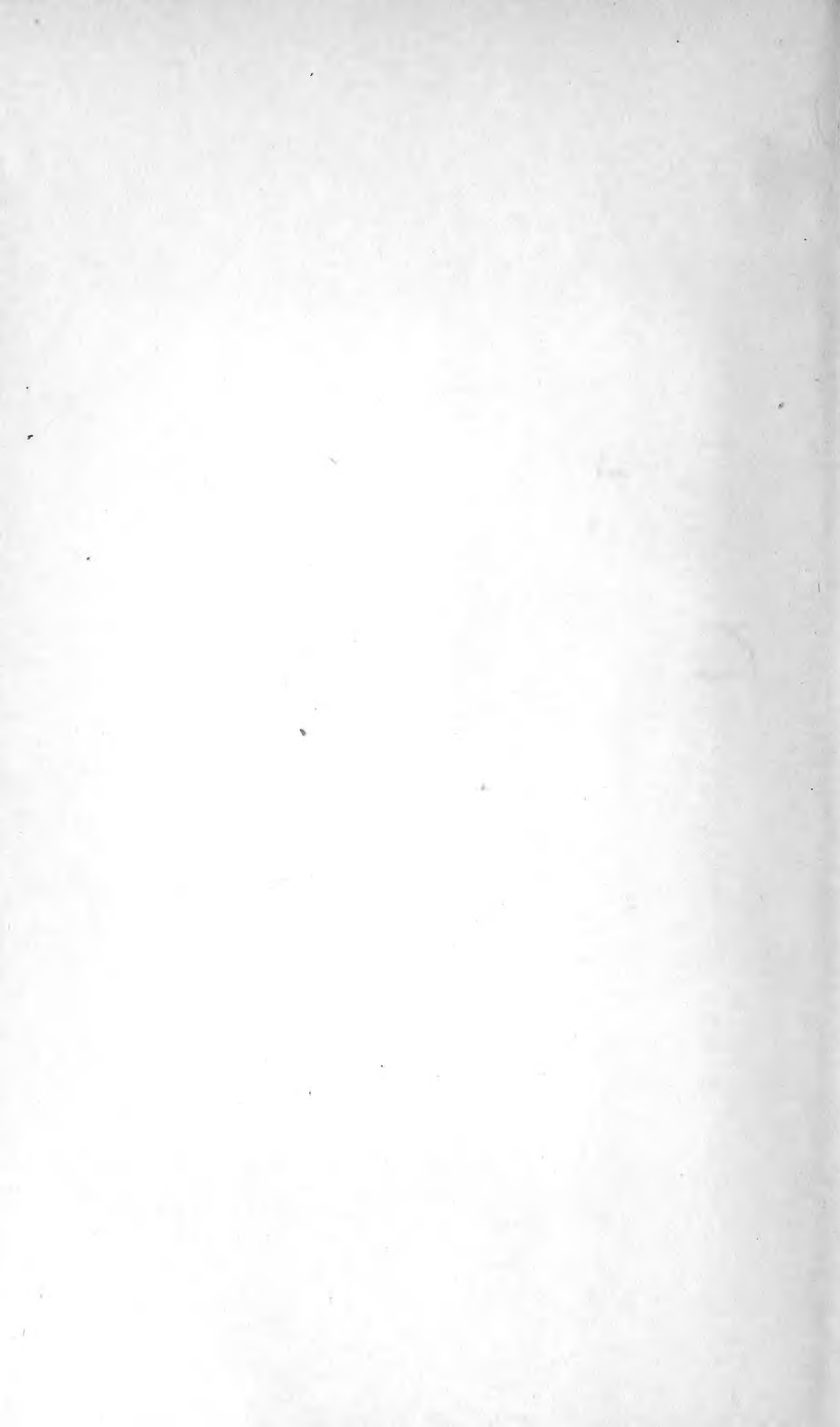
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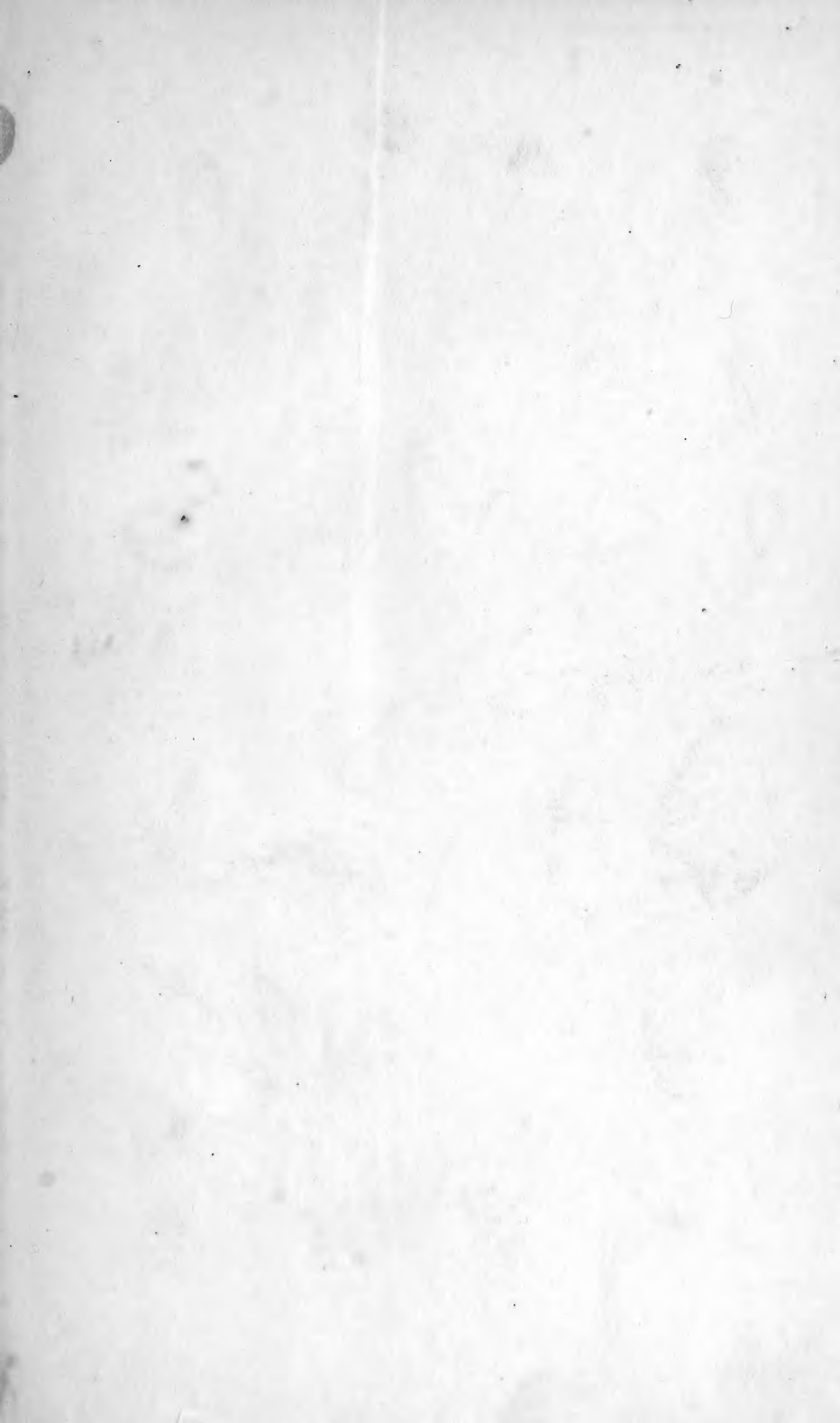


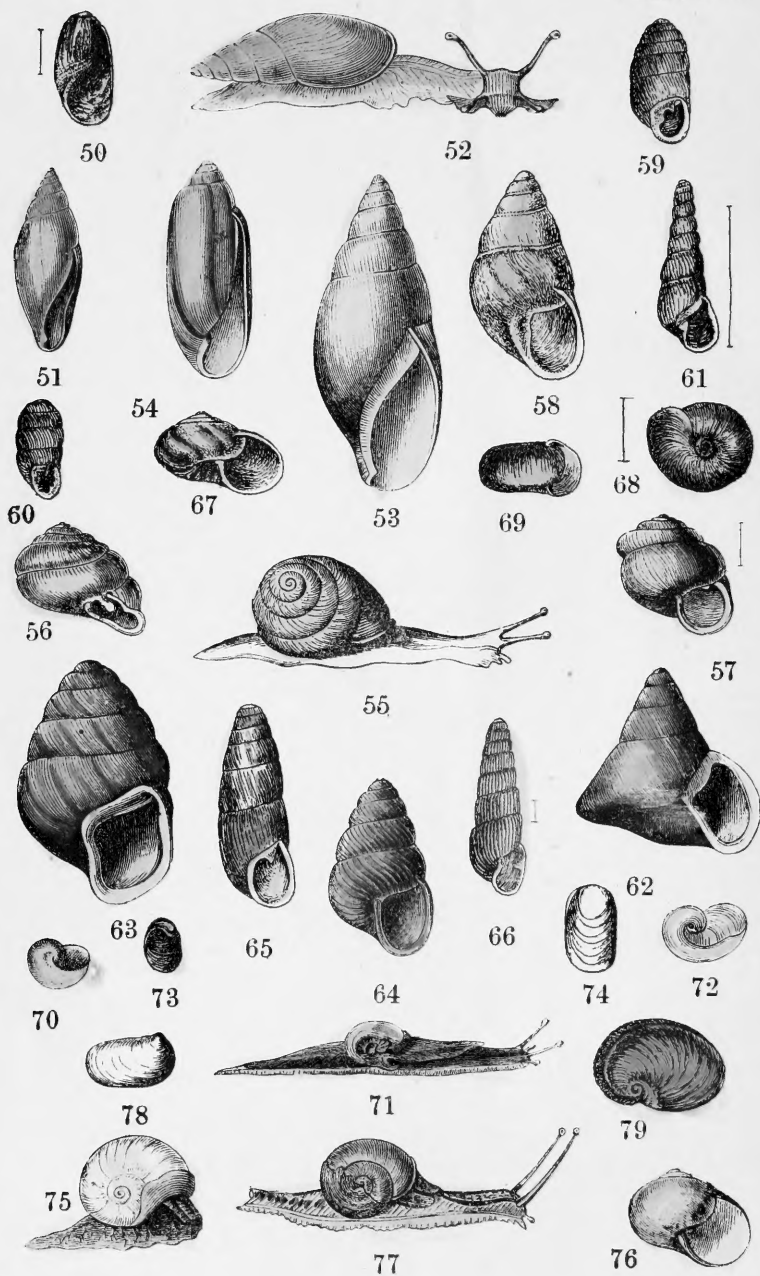
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MOLL

STRUCTURAL
AND
SYSTEMATIC
CONCHOLOGY:

AN INTRODUCTION TO THE STUDY OF THE

MOLLUSCA.

Division of Mollusks
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VOL. III.

BY GEORGE W. TRYON, JR.

CONSERVATOR OF THE CONCHOLOGICAL SECTION OF THE ACADEMY OF NATURAL
SCIENCES OF PHILADELPHIA.

PHILADELPHIA :
PUBLISHED BY THE AUTHOR,
Academy of Natural Sciences, Cor. 19th & Race Sts.

1884.

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William P. Kildare, Printer, 734 & 736 Sansom St., Phila.

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SYSTEMATIC CONCHOLOGY.

SUBCLASS PULMONATA.

This division embraces all the land and fresh-water mollusca which breathe air. They are normal gastropods, having a broad foot, and usually a large spiral, holostomate, inoperculate shell (operculate in *Amphibola*). Their breathing organ is the simplest form of lung, resembling the branchial chamber of the sea-snails, but lined with a network of respiratory vessels. The respiratory orifice is small and contractile to prevent too rapid desiccation in the land-snails, and to exclude water in the aquatic genera. Most of them have sufficiently large shells to contain the animal; in a few the shell only shelters a portion of the animal, or it is internal and of simple structure, or rarely absent. Snail-shells contain a larger proportion of animal matter than sea-shells, and their structure is less distinctly stratified. The Pulmonata are mostly terrestrial, but some genera are fluviatile and a few inhabit damp places near the sea, where at high-tide they are covered by its waters. The sexes are united in each individual, but the genital orifices are sometimes contiguous, opening in a common cloaca, and sometimes distant. Through the *Cyclostomæ* or operculated land-snails and the *Ampullariæ* they are related to the phytophagous sea-snails, through *Siphonaria* and *Gadinia* to the limpets, and through *Onchidium* to the nudibranchs.

Land-snails are universally distributed; but the necessity for moist air, and the vegetable nature of their food, favor their multiplication in warm and humid regions: they are especially abundant in islands, whilst in hot and desert countries they appear only in the season of rain or dews. Their geological history is less complete than that of the purely marine orders; but their antiquity might be inferred from the distribution of peculiar genera in remote islands, associated with the living representatives of the ancient fauna of Europe. Fresh-water snails

(Linnæidæ) occur in the English Wealden, but fossil land-snails have not been found in strata older than the tertiary in Europe, and then under forms generically, and even in one instance specifically, identical with living types of the New World (*Megaspira*, *Proserpina*, *Glandina*, and *Helix labyrinthica*).—*Woodward*.

The oldest American fossils of this subclass occur in the Carboniferous.

The lingual dentition of the Pulmonata confirms, in a remarkable manner, those views respecting the affinities of the subclass, and its zoological value, which have been deduced from the more obvious characters afforded by the animal and shell. They have, without known exception, rows of very numerous, similar teeth, with broad bases, resembling tessellated pavement. Their crowns are recurved, and either aculeate or dentated. The lingual ribbon is very broad, often nearly as wide as it is long; and the number of teeth in a row (though usually a third less) is sometimes as great, or even greater, than the number of rows. The rows of teeth are straight or curved or angulated; when the rows are straight the teeth are similar in shape; curves indicate gradual changes, and angles accompany sudden alterations of form.—*Woodward*.

The jaw is single, or is composed of three pieces, never of two pieces as in the branchiferous snails.

In the young snails the temporary vellum is rudimentary or absent, with the exception of the maritime genera, in which it is well-developed. The first development of the shell, at least in *Limax*, *Clausilia* and *Helix*, is within, instead of on the exterior surface of the mantle as in the other gastropods. It is similar in most cephalopods, but in these the shell continues internal, whilst in most of the pulmoniferous genera it becomes external at an early period.

The Pulmonata are conveniently divided into the orders:—

1. *STYLOMMATOPHORA* (*Geophila*, *Ads.* *Nephropneusta*, *Ihering*).—Eyes at the ends of the superior tentacles.

2. *BASOMMATOPHORA* (*Branchiopneusta*, *Ihering*).—Eyes at the base of the tentacles.

ORDER STYLOMMATOPHORA.

Terrestrial mollusks having four tentacles, the superior pair invaginate or retractile, oculiferous at their extremities. They may be divided into *Monotremata* and *Ditremata*, according to the union or separation of the sexual openings.

SUBORDER MONOTREMATA.

Male and female orifices united; oculiferous tentacles invertible.

* *Agnatha*. Mouth without jaw; generally no median tooth in the radula; lips often developed into feeler-like appendages; neck commonly elongated, and peculiarly furrowed on the back.

FAMILY TESTACELLIDÆ.

Animal slug-like, bearing a small ear-shaped shell near the posterior extremity of the body. No jaw. Lingual teeth long and narrow, sharp-pointed, in oblique series.

TESTACELLA, Cuvier, 1800.

Etym.—Diminutive of *testa*, a shell.

Syn.—*Helicolimax*, partim, Fer., 1807. *Testacellus*, Faure-Biguet, 1801.

Distr.—17 sp. Europe, Canary Islands. Fossil, 2 sp. European tertiary, *T. haliotideæ*, Fer. (c, 42; ci, 44).

Animal limaciform, subcylindrical, tapering anteriorly; tentacles simple; mantle small, posterior, quite near the tail, covered with a small external shell; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; no distinct locomotive disk; external respiratory and anal orifice at the posterior right edge of the mantle under the peristome of the shell; combined generative orifice behind and below the right eye-peduncle.

Shell external, rudimentary, imperforate, ear-shaped, with a subspiral, posterior nucleus.

“The *Testacella* is one of the few land-mollusks with true predaceous habits; its marine representatives in this respect being the cuttle and the whelk. It is scarcely inferior to the tiger, snake or shark in its cunning and ferocity. Its prey chiefly consists of earth-worms, which it hunts underground and pursues through their galleries, crouching occasionally and making a spring on its victim. It is said that when the poor worm has had the start of its pursuer, the snail-slug intercepts it by tunneling across the line of its retreat. It will devour a lob-worm much longer than itself, seizing it in the middle; and when the writhings have been succeeded by exhaustion, it detaches and swallows one-half of the worm; and after that has been digested it finishes its long meal with the other portion. For this purpose its mouth is furnished with an apparatus of sharp recurved teeth, which enables the *Testacella* to retain a firm hold of its victim and swallow it more easily. The worm is provided with some means of defense, in the rows of stiff bristles which encircle its rings; and by contracting its body a short respite is occasionally gained. But the chance of ultimate escape or safety is very slight. When the *Testacella* sees or scents its prey, it glides softly and cautiously towards it; and, apparently without taking any notice of the worm, it seems to feel its way, and usually succeeds in fastening itself on an unprotected part of the body between the rings. The attack, if unsuccessful at first, is renewed; but if the worm resists too long, the *Testacella* gets impatient, and by pressing or doubling its victim into the earth, by which

means the rings are forced open, its purpose is effected and the meal secured.

"Although it also feeds on slugs and snails, and even on its own species (the shells of which have been found in its stomach), it will not eat dead animals, and even refuses pieces of a fresh worm which has been chopped up to feed it. It only sallies out at night in search of its prey, burying itself deep in the ground during the daytime. After having gorged itself with a worm, it rests many hours in a half-torpid state until the meal has been digested; and it can remain fasting a long time (as much as fourteen or fifteen nights), until hunger compels it to make a fresh hunt. It does not fear the cold, or appear to suffer any inconvenience from it except when the ground is hardened by frost; and in this respect it resembles the slugs, the Vitrinæ, and some of the Zonites, some of which are nearly as carnivorous and hardy as the Testacella. The average length of life in the Testacellæ appears to be five or six years. Their smell is like that of worms, only more nauseous. They chiefly frequent gardens, where they are sure of finding their proper food; but they may occasionally be met with in woods near inhabited places, as well as at the foot of old walls. In winter they bury themselves very deep in the ground; and my gardener once brought me living specimens of *T. Maugei* which he had dug up in trenching some celery-roots at a depth of about two feet. The eggs are laid separately and are very large in proportion to the size of the body. These somewhat resemble hens' eggs both in shape and consistency, and are covered with a rather thick and tough skin. If they are taken out of the earth and exposed to a cold air, they frequently crack and burst in pieces which fly off to some little distance."—*Jeffreys' Brit. Conchology*.

During winter and dry weather the Testacella forms a sort of cocoon in the ground by the exudation of its mucus. If this cell is broken, the animal may be seen completely shrouded in its thin opaque white mantle, which rapidly contracts until it extends but a little way beyond the margin of the shell. It was introduced into Great Britain, where it is becoming common.

DAUDEBARDIA, Hartmann, 1821.

Etym.—Dedicated to Daubebard de Ferussac, a celebrated French conchologist. *Syn.*—*Helicophanta*, Fer., 1822.

Distr.—13 sp. Central and eastern Europe, Algiers, New Zealand. *D. Gaillardotii*, Bourg. (ci, 45, 46). Syria.

Animal limaciform, subcylindrical, tapering anteriorly; tentacles simple; mantle small, posterior, quite near the tail, covered with a small, external shell; longitudinal furrows above the margin of the foot; usually no caudal mucous pore; external respiratory and anal orifice at the posterior right margin of

mantle, under the peristome of the shell. Predaceous, devouring small *Helices*, *Vitrina* and *Clausilia*.

Shell small, external, perforate, depressed; paucispiral, whorls rapidly increasing.

RUFINA, Clessin. Shell umbilicated. *D. rufa*, Drap.

PSEUDOLIBANIA, Stefani. Shell haliotiform, spire very short, narrowly rimate, columellar lip slightly reflected over the umbilical slit. *D. Langi*, Pfr.

LIBANIA, Bourg. Umbilicus covered in the adult. *D. Saulcyi*, Bourg.

ISSELIA, Bourguignat. Shell perforated. Animal with caudal mucous pore. *D. (Helicarion) Sardous*, Issel.

CHLAMYDOPHORUS, Binney, 1879.

Distr.—*C. Gibbonsi*, Binney (ci, 47). Natal.

Mantle covering the whole body, with an orifice on the centre of the back near the tail, enclosing at the same part a solid internal shelly plate; no caudal mucous pore; no jaw; teeth as in *Glandina*. Position of the genital orifice unknown.

PLECTROPHORUS, Fer., 1819.

Distr.—5 sp. *Teneriffe*. *P. Orbigny*, Fer. (ci, 48).

Animal elongated, subcylindrical, with a tough dorsal anterior integument or mantle, under which is the pulmonary cavity, having its orifice on the right side, with the anal orifice near it; there is a second long and narrow posterior mantle, and an external rudimentary conical, non-spiral shell near the posterior extremity; upper tentacles longest, oculiferous, retractile.

This animal has not been recognized; the doubly armored back and conical external shell are both improbable characters.

SELENOCHLAMYS, Böttger, 1883.

Distr.—*S. pallida*, Böttg. *Caucasus*.

Animal resembling *Daudebardia*, but without a shell; mantle small, the surface divided by longitudinal sulcations; tail short, compressed, carinated; foot narrow, tripartite.

FAMILY OLEACINIDÆ.

Shell fusiform, corneous, more or less transparent, rarely banded longitudinally; aperture longitudinal, narrow; columella twisted or truncated at its base. Lingual teeth numerous, in more or less curved, transverse rows, the central teeth inconspicuous, the marginal aculeate, or with a single, long, recurved apex (xiii, 56, 57). Head short, with a retractile, often produced, buccal sac; eyes at the tips of elongated, cylindrical, retractile peduncles; inferior tentacles moderate, situated below the eye-peduncles; foot elongate, narrow, simple posteriorly.

Living in humid situations; carnivorous.

STREBELIA, Crosse and Fischer, 1868.

Syn.—Physella, Pfeiffer, 1861 (not Hald., 1842). Spirobulla, Ancey, 1881.

Distr.—1 sp. Mexico. *S. Berendti*, Pfeiffer (xcii, 50).

Shell bulliform, spire very short, the last whorl elongated, comprising nearly the entire length of the shell; columella simple, arcuated, not truncate; peristome simple, acute. Animal much larger than the shell.

OLEACINA, Bolten, 1798.

Syn.—Cochlicopa, Fer., 1819. Pfaffia, Behn., 1844.

Distr.—142 sp. U. S. (Gulf States), West Indies, Mexico, Central American, Northern South America, So. Europe (one species), Algiers. Fossil. Cret.—; Europe.

Shell oval-oblong, with a thin, smooth olivaceous epidermis; last whorl large, sometimes attenuated at the base; aperture elliptical-oblong, equaling or exceeding half the length of the shell; outer lip simple, sharp, usually somewhat inflected in the middle.

VARICELLA, Pfeiffer, 1855. Shell with longitudinal varices. *O. leucozonias*, Walch.

MELIA, Albers, 1850. Shell fusiformly turreted, longitudinally subcostate; whorls rather flattened; columella twisted, obliquely truncate; aperture narrow, semioval; lip simple, submarginate within. *O. simplex*, Strebel.

BOLTENIA, Pfeiffer, 1878. Typical group of Oleacina. *O. oleacea*, Fer. (xcii, 51). Cuba.

POIRETIA, Fischer, 1883. Animal with feebly developed labial palpi. Formed for *O. Algira*, Brug., the only European species.

GLANDINA, Schum., 1817. (Polyphemus, Mont., 1810. Euglandina, Crosse and Fischer, 1870.) Shell oblong-oval, fusiform, corneous, covered by a thin, fugacious epidermis; spire more or less elevated, of six or eight whorls; columella thin, arcuated, truncated at base; aperture rather narrow, longitudinal; lip sharp, simple.

Animal much longer than the shell, when extended; oculiferous tentacles deflected at the tips, beyond the eyes; inferior tentacles much shorter, also deflected; lips elongated, tentacular (vi, 72). *O. Carminensis*, Morelet (xcii, 52). *O. truncata*, Gmel. (xcii, 53). Florida. These animals are predaceous in their habits, and carnivorous; they attack with avidity Bulimi as large as themselves, and devour them. When they have chosen a victim they probe the aperture with their palps before penetrating it; the buccal mass is then protruded, and the contents consumed through the aperture they make. The species inhabit tropical America—mainly Mexico and Central America, although a few species occur in the southern United States. The shells are of larger size

than the other groups of the genus, in some species attaining a length of three inches.

SELASIELLA, Strebel, 1878. Shell very small, glossy, vertically striated; columella truncated; labial palpi wanting. The stomach is simple as in *Streptostyla* (but is double in *Glandina*). 3 sp. Mexico. *O. perpusilla*, Pfeiffer.

[PSEUDOSUBULINA, Strebel and Pfeffer, 1882.

Distr.—Mexico. *P. Chiapensis*, Pfeiffer.

Shell turriculated, whorls numerous, narrow, the last much smaller than the others; columella truncated at the base; peristome simple.

Animal without jaw.

VOLUTAXIS, Strebel and Pfeffer, 1882. Columella with a basal plication. *Spiraxis Berendti*, Pfeiffer. Mexico.

The shells resemble Subulina and Spiraxis, but the animal has no jaw.]

STREPTOSTYLA, Shuttleworth, 1852.

Distr.—49 sp. Tropical America, West Indies.

Shell oval-oblong, subcylindrical, the last whorl proportionally very large, cylindrical; aperture elongated, narrow behind; outer lip simple, inflected in the middle; columella with a thickened fold at the base.

Animal: tentacles but slightly developed, labial palpi moderate, foot short.

The texture and general form of the shell do not much differ from some species of *Oleacina*, but the genus is at once distinguished by its columellar fold, instead of the truncation of *Oleacina*.

STREPTOSTYLA (restricted). Shell longitudinally striated. *S. Nicoleti*, Shuttl.

CHERSOMITRA (Shuttleworth), Albers, 1860. Shell cylindrical, smooth, shining, usually yellowish; aperture more than half the length of the shell; outer lip distinctly inflected. Mexico, Guatemala. *S. Delattrei*, Pfr. (xcii, 54). Central America.

PETENIA, Crosse and Fischer, 1868. Distinguished by the presence of a muciparous pore at the end of the foot; tentacles and buccal lobes as in *Glandina*; foot truncated behind. Spire lengthened; columella twisted. *S. ligulata*, Morelet.

FAMILY STREPTAXIDÆ.

Shell heliciform or pupiform, often with the last whorls obliquely deviating.

Animal with a long neck and short tail; superior tentacles long, narrow; labial palpi narrow, moderate.

STREPTAXIS, Gray, 1837.

Syn.—Artemon, Beek, 1837.

Distr.—75 sp. Mostly South American; Africa; East Indies.

Shell oval, heliciform but often oblique, profoundly umbilicated; whorls rapidly enlarging, deviating from the original axis more or less; aperture lunar, with or without teeth; lip slightly thickened and reflected.

The principal character of the group is found in the singular oblique spiral of the whorls causing a torsion of the axis of revolution.

ARTEMON, Pfeiffer, 1855. (Epistylia, Pfr., 1877.) Aperture without teeth; shell subregular. American. *S. candidus*, Spix.

SCOLODONTA, Döring. Shell similar to that of Hyalina. Front part of the animal elongated; teeth of the radula dagger-shaped, the median very short, rhombic. *S. Semperi*, Döring. Argentine Republic.

AMMONOCERAS, Pfeiffer, 1855. Shell depressed orbicular, shining, pellucid, thin, radiately striate; umbilicus wide, perspective; spire rather flattened; last whorl not descending at the aperture, the periphery rounded; aperture large, rounded lunate; lip simple, acute, its extremities approaching. *S. omolomorpha*, Orb.

DISCARTEMON, Pfeiffer, 1855. Shell conoidal or discoidal; parietal wall and outer lip armed with teeth. *S. discus*, Pfr.

EUSTREPTAXIS, Pfeiffer, 1877. Typical group. *S. contusus*, Fer. (xcii, 55). *S. comboides*, d'Orb. (xcii, 56). *S. deformis*, Fer. (xcii, 57).

ODONTARTEMON, Pfeiffer, 1855. Shell ovate; parietal wall and outer lip armed with teeth. *S. bulbulus*, Morelet.

OMPHALOPTYX, Böttger, 1875.

Distr.—Hesse. *O. supracostata*, Böttger. Fossil.

Shell heliciform, subperforated, conical and costulated above, smooth below; last whorl very large, a little contracted at the aperture; aperture small, a little oblique, semilunar; outer lip simple, sharp; columella thickened at the base, reflected over the umbilical perforation; parietal wall with a horizontal plication. Is supposed to be related to Streptaxis.

ENNEA, H. and A. Adams, 1855.

Distr.—58 sp. Africa, Mauritius, Madagascar, India, etc. *E. Liberiana*, Lea (xcii, 58). Liberia.

Shell subcylindrical, slightly rimate, apex obtuse, smooth, shining, hyaline; whorls flattened, the last narrow, sulcate externally in the middle, lamellate within, with a strong plait parallel to the columella; aperture subcircular; parietal lamella extending inwards and situated close to the right margin;

peristome expanded, the right margin flexuous, thickened in the middle.

EDENTULINA, Pfeiffer, 1855. Peristome not toothed. *E. ovoidea*, Brug.

ELMA, H. Adams. A strong sinus at the outer lip; aperture edentulous. *E. Swinhoei*, H. Adams. Formosa.

GONAXIS, Taylor. Shell pupiform, axis of the apical whorls diverted to the right.

UNIPLICARIA, Pfeiffer, 1855. Parietal margin lamellate; outer lip edentulous. *E. cerea*, Dunker (xcii, 59). Madagascar.

ENNEASTRUM, Pfeiffer, 1855. Parietal and outer margins of aperture both lamellate. *E. elegantula*, Morelet.

GULELLA, Pfeiffer, 1855. Shell ovate, parietal margin lamellate; outer lip multidentate. *E. capitata*, Gould (xcii, 60). E. Africa.

PTYCHOTREMA, Mörch, 1852. (Cyclodontina, Beck, 1837.) *E. Guineensis*, Beck.

HUTTONELLA, Pfeiffer, 1855. Shell cylindrical, parietal margin plicate; outer lip quadridentate. *E. Kraussi*, Pfeiffer.

DIAPHORA, Albers, 1850. Cylindrical, umbilicated, apex obtuse, base obsoletely carinate; whorls ten, flattened, the last detached; aperture pyriform, with slightly expanded lip. 2 sp. Indo-China, Philippines. *E. Cyindrelloidea*, Stol.

STREPTOSTELE, Dohrn, 1866.

Distr.—4 sp. Prince's Isl., Africa. *S. Nevilli*, H. Adams (xcii, 61). Seychelles.

Shell of the form of Achatina, but hyaline as in Streptaxis and Ennea; pillar-lip short, twisted and thickened. Color of the animal intensely red or yellow, as in the two last-named genera.

GIBBULINA, Beck, 1837.

Syn.—Gibbus, H. and A. Adams, 1855.

Distr.—43 sp. Mauritius, Isle of France, Madagascar, Seychelles.

Shell corneous or white, solid, calcareous, pupiform or turbinate, summit obtuse; last whorl gibbous, sometimes angulated and deformed; umbilicus large, not deep; lip reflected, its extremities united by a callus; columella sometimes plicate.

GIBBUS, Montf., 1810. Shell subconical, whorls irregular, laterally compressed. *G. Lyonettiana*, Pall. (xcii, 62). Isle of France.

GONIODOMUS, Swains., 1840. (Idolum, Pfeiffer, 1855.) Ovate, ventricose, obliquely costulate. *G. pagoda*, Fer. (xcii, 63). Mauritius.

PLICADOMUS, Swains., 1840. Spire moderate, subconic, obtuse; outer lip reflected; surface obliquely costulate. *G. sulcata*, Müll. (xcii, 64). Mauritius.

GNOSPIRA, Swainson, 1840. (Gibbulina, Pfr., 1855.) Typical group. *G. palanga*, Fer. (xcii, 65). Isle of France.

NEVILLIA, Martens. Whorls narrow, with strong perpendicular ribs. 3 sp. Mauritius. *G. clavulata*, Lam.

RAVENIA, Crosse, 1873.

Distr.—*R. Blandi*, Crosse (xcii, 66). Curaçao.

Shell allied to Spiraxis and Pupa, turreted, imperforate, subhyaline, columellar margin spirally twisted, outer margin bent inwards, and with a strong tooth in the middle.

FAMILY HELICOIDEA.

Shell heliciform, with usually depressed conical spire, and umbilicated; outer lip simple.

Animal differing from the true Helices by the absence of a jaw.

RHYTIDA, Albers, 1860.

Distr.—31 sp. Australia, Tasmania, New Caledonia, etc. *R. bullacea*, Pfr. (xcii, 67). Australia.

Shell umbilicate, thin, convexly depressed; undulately rugose or striate; spire slightly elevated; whorls four or five, slightly flattened; umbilicus wide and deep; aperture oblong-ovate, sometimes dentate within; lip simple, acute, its extremities approaching.

Viviparous. Teeth rather few, oblique, arcuated.

DIPLOMPHALUS, Crosse and Fischer, 1873. Shell discoidal, planorbiform, spire depressed; peristome simple, connected by a much-developed parietal callus. 13 species. New Caledonia, New Zealand, Australia. *D. Megei*, Lamb. (xciii, 68, 69). N. Caledonia. Differs from Rhytida by the very wide umbilicus and sunken excavation of the upper face of the shell; in the radula by the equal size of the lateral teeth.

GUESTIERIA, Crosse, 1872.

Distr.—*G. Powisiana*, Pfr. New Grenada.

Shell imperforate, corneous, thin, depressed, quite involute, the last whorl only visible; aperture like that of Nautilus; peristome thin, simple. Animal unknown.

AEROPE, Albers, 1860.

Distr.—*A. caffra*, Fer. So. Africa.

Shell very thin, subglobose, costulately striate, with narrow umbilicus; spire not prominent, obtuse; whorls four, ventricose, strongly striated, the last descending at the aperture; aperture large, semioval; lip simple, acute; columellar margin widely reflected.

Teeth very long, subulate, arranged in converging lines.

PARYPHANTA, Albers, 1850.

Distr.—New Zealand, Australia. *P. Busbyi*, Gray (xciii, 82).

Shell widely umbilicated, depressed, covered by a thick, shining, coriaceous epidermis, enveloping the peristome; aperture oblique, semilunar; peristome simple.

** *Gnathophora*. Mouth with jaw. Modern malacologists have arranged the families of this division of the Pulmonata in accordance with the structure of the jaw, and to a certain extent this accords with the arrangement by external characters—mainly of the shell. I adopt

† *Holognatha*. Jaw simple, without superior appendage. Helices, Bulimi, Cyliindrellæ, Pupæ, Limaces, etc.

†† *Elasmognatha*. Jaw with a superior quadrangular accessory plate. Succineæ.

† *Holognatha*.

Includes, as shown above, most of the terrestrial pulmonates. A further division has been attempted according to the ornamentation of the jaw, but the number of observations made upon this organ are not sufficiently numerous to justify a classification in accordance therewith; particularly as the groupings heretofore effected are often in disaccord with obvious relations of the shell.

The arrangement followed in these pages is mainly that of Pfeiffer's "Nomenclator Heliceorum Viventium," but with some modifications and additions. The naked snails I have preferred to interpose between the Helices and Succineæ, as proposed in Gill's Classification (vol. i, 266), rather than preceding the Helices, as in Fischer.

I give herewith the names and descriptions of the proposed divisions of the Holognatha, founded upon jaw characters, with the principal genera which have been referred to each. Upon the value of these characters, see Binney's remarks (vol. i, 261).

I. *Oxygnatha*: Jaw smooth, edge cutting, often with a median prominence. Philomycus, Limax, Tennentia, Parmacella, Helicarion, Ariophanta, Nanina, Rhysota, Vitrina, Hyalinia, Zonites, Leucochroa, Rumina, Clausilia; perhaps also Phania, Planispira, Solaropsis, Otala, Caracolla, Labyrinthus.

II. *Aulacognatha*: Jaws finely and regularly grooved, edge crenulated. Ena, Pupa, Discus, Vallonia; perhaps also Sagda and Hygromia (Fruticola).

III. *Stegognatha*: Jaw finely plicated; the plications imbricated, parallel or oblique to the centre. Punctum, Bulimulus.

IV. *Odontognatha*: Jaw strongly ribbed, edge toothed. Veronicella, Arion, Ariolimax, Anadenus, Pellicula, Peltella, Moreletia?, Pfeifferia, Chloræa, Axina, Pythohelix, Helicobulimus, Cochlicellus, Jacosta, Euparypha, Eulota, Triodopsis, Trigonostoma,

Arionta (including Chilotrema and Campylæa), Iberus, Tachea, Pomatia, Pleurodonta, Thelidomus, Limicolarius, Achatina, Borus.

V. Goniognatha: Jaw composed of several pieces, joined together in oblique lines. Pseudostrombus [= Liguus], Orthalicus.

FAMILY VITRINIDÆ.

Animal with or without mucous caudal pore, tail often obliquely truncate; mantle-margin sometimes more or less produced, or reflexed over the sides, or entirely covering the shell, which the animal is too large to entirely enter.

Shell usually thin, corneous, transparent, spiral, of few, rapidly enlarging whorls.

VITRINA, Drap., 1801.

Syn.—*Helicolimax*, Fer., 1821. Cobresia, Hübner, 1810. *Limacina*, Hartmann, 1821. *Parmacellina*, Sandberger.

Distr.—93 sp. Universal. Mostly inhabit cold or temperate countries or mountain regions of warm countries. Fossil. Eocene of Europe.

Shell imperforate, very thin, depressed; spire short, last whorl large; aperture large, lunate or rounded, columellar margin slightly inflected, peristome often membranous.

Animal elongated, too large for complete retraction into the shell; tail very short; mantle reflected over the shell-margin, and furnished with a posterior lobe on the right side; without a caudal mucous pore. Lingual plate with central tooth tricuspid, laterals bicuspid; marginals acuminate, slim, bicuspid. Occasionally animal-feeders, like the slugs.

They live in moist situations, among loose earth, stones, grass and moss. They are very lively, crawling constantly about, and when touched will sometimes jump several inches from the ground.

OLIGOLIMAX, Fischer. Shell small, sculptured, minutely perforate. Mantle not much extended beyond the shell in front. Animal contractile within the shell. *V. annularis*, Studer. Europe.

SEMLIMAX, Stabile, 1859. Animal not able to withdraw entirely within its shell; shell imperforate. *V. diaphana*, Drap.

PHENACOLIMAX, Stabile, 1859. Animal capable of withdrawing entirely within its shell, and forming a vitreous epiphragm. *V. major*, Fer. (xcii, 70). Europe. *V. fasciata*, Soul. (xcii, 71, 72). Philippines

GALLANDIA, Bourguignat. (*Trochovitrina*, von Martens.) Spire conical, last whorl more or less angular, umbilicus perforated. Animal wholly retractile within the shell. *V. Lederi*, Büttger. 3 sp. Caucasus, Turkestan.

VITRINOZONITES, Binney.

Distr.—*V. latissima*, Lewis. Tennessee.

Shell like *Vitrina*. Animal having a caudal mucous pore with longitudinal furrow; no appendiculate mantle-process; marginal teeth of radula simple, not bifid.

VELIFERA, Binney.

Distr.—*V. Gabbi*, Binney. Costa Rica.

Shell as in *Helicarion*. Animal: mantle with one or more accessory processes which cover most of the shell; a simple longitudinal mucous pore, without horn-shaped process; jaw with smooth anterior surface, and beak-like projection on the cutting edge; radula resembling *Zonites*.

PARMELLA, H. Adams, 1867.

Distr.—*P. planata*, H. Ad. (xcii, 79). Fiji Isles.

Animal undescribed. Shell depressed, spire flat, epidermis horny, polished, extending greatly beyond the posterior part of the margin.

VITRINOIDEA, Semper, 1873.

Distr.—*V. Albaiensis*, Semper. Philippines.

Shell wholly concealed by the mantle, with cuticle and calcareous layer, forming several whorls; respiratory orifice before the middle of the mantle; no caudal mucous pore; marginal teeth of the radula three-pointed; jaw smooth; accessory glands at the genital organs; no flagellum.

VITRINOPSIS, Semper, 1873.

Distr.—2 sp. Philippines. *V. tuberculata*, Semper.

Two lobes of the mantle covering a part of the shell in front and on the left side, not on the right as in *Vitrina*. Lateral teeth of the radula three-pointed, not 1–2 pointed as in *Vitrina*.

VITRINOCONUS, Semper, 1873.

Distr.—9 sp. Philippines. *V. cyathus*, Pfeiffer.

Shell umbilicated, conical or trochiform, apex obtuse; whorls planulate, the periphery carinate or angulate; aperture lunate; peristome simple, acute or thickened.

Mantle sometimes with cervical lobes, but no shell-lobe; lateral teeth of the radula two-pointed.

LACONIA, Gray, 1855.

Distr.—1 sp. *L. Ferussaci*, Gray.

Body subglobose; mantle edged, produced in front, forming a broad collar.

Shell subglobose, entirely and permanently covered by a thin expansion of the mantle; spire of few whorls, the last very large; aperture very large, lunate.

HELICARION, Fer., 1821.

Syn.—Austenia, Nevill. ? Hoplites, Theobald, 1864.

Distr.—95 sp. India, East Indies, Philippines, Australia, Abyssinia. *H. flammulata*, Quoy (xcii, 77). Celebes.

Shell heliciform, rounded-oval, thin, fragile, covered with a very light epidermis; spire short, whorls few, the last much swollen; aperture large, oblong-triangular; peristome simple, sharp.

Animal not entirely retractible within the shell; mantle produced in front into two lobes upon the neck, and posteriorly, on the right side into a lobe partly covering the shell; foot truncated behind, the sole divided longitudinally into three parts.

ZONITARION, Pfeffer, 1883. Jaw without middle tooth. *H. semimembranaceus*, von Martens.

OTESIA, H. and A. Adams. (Vitrinella, Gray.) Mantle-lobe covering the greater part of the shell. Shell imperforate, very thin, spire conic.

FAMILY ZONITIDÆ.

Animal able to withdraw completely within its shell; provided with a caudal mucous pore. Jaw produced in the middle. Lateral teeth bicuspid, marginals acuminate, unicuspidate or bicuspidate.

Shell usually depressed heliciform, umbilicated, thin, more or less transparent, with simple, sharp peristome.

The hyaline structure of the shell and the acute margin of the aperture most readily distinguish these shells from the Helicidæ, with which they are usually confounded.

ZONITES, Montfort, 1810.

Syn.—Archæozonites, Sandb.

Distr.—Europe and America. Fossil. Tertiary.

Shell subdepressed, umbilicated, very thin, more or less transparent; aperture semilunar, usually without teeth; lip thin, sharp.

Animal elongated, completely retractile within the shell; jaw with a well-marked middle rostrum, lateral teeth bicuspid, marginals unicuspid, sharp; foot with caudal mucous pore or slit. The Asiatic group Ariophanta has a similar shell, but the mantle-lobes are reflected upon it.

ZONITES (restricted). (Ægopis, Fitzinger, 1833. Tragomma, Held, 1837. Helicodes, Dumas, 1847. Verticillus, Moquin-Tandon, 1855.) Labial palpi small; caudal gland reduced to a simple groove, shell depressed orbicular, widely umbilicated; striated above, smooth below; lip sharp, with a slight callus on the parietal wall. Southern Europe, Asia Minor. 12 sp. *Z. Algirus*, Linn. (xciii, 92).

STENOPUS, Guilding, 1828. (*Guppya*, Mörch, 1867. *Habroconus*, Crosse and Fischer, 1872.) Animal with a narrow locomotive disk, and a border on either side, as in *Vaginula*; caudal gland with a retractile appendage. Shell perforated, conical or depressed, thin, diaphanous; peristome simple. 5 sp. St. Vincent, W. I., Mexico, Venezuela. *S. cruentatus*, Guild (xciii, 91). St. Vincent, W. I.

OMPHALINA, Rafinesque, 1819. (*Moreletia*, Gray, 1855. *Edusa*, Albers, 1860. *Zonyalina*, von Martens, 1865.) Shell widely umbilicated, striated above, smooth below. Labial palpi large, caudal pore well developed. 14 sp. United States, Mexico, Guatemala. *Z. fuliginosus*, Griffith (xciii, 96). U. S. *Zonyalina* is said to be distinguished from *Moreletia* by the want of the outer cervical lobe of the mantle.

MESOMPHIX, Rafinesque, 1819. Shell umbilicated or perforated, globosely depressed, thin, striated, reddish horn-color, lighter below, shining; whorls four-and-a-half to six; aperture lunar ovate; peristome simple, straight, acute, extremities approaching, that of the columella subreflexed. *Z. ligerus*, Say (xciii, 97). Several species, mostly United States. Barely distinguished from *Omphalina* by a more elevated spire.

ÆGOPINA, Kobelt. (*Retinella*, Shuttl.) Proposed for *Z. olivetorum*, Gm. (xciii, 95), and allied European species, scarcely distinct from the North American group *Omphalina*.

HYALINA, Agassiz, 1837. (*Aplostoma*, Moquin-Tandon, 1855.) Shell depressed or conical, more or less longitudinally, but not spirally striate; semitransparent, smooth and shining; umbilicus large, rarely small or none; epiphragm none, rudimentary or vitreous. Flagellum none or short, thick and steadied by a terminal muscle; mucous vesicles represented by a glandular layer. 50 sp. Mostly Europe and North America. *Z. cellarius*, Müller.

VITREA, Fitz., 1853. (*Crystallus*, Lowe, 1854.) Shell small, fragile, shining, hyaline, smooth, convexly depressed, perforate or imperforate; whorls 4-6, the last not deflected at the aperture; aperture lunate, the lip simple, acute. Europe. *H. crystallina*, Müll.

POLITA, Held, 1837. (*Oxychilus*, Fitz., 1833. *Lucilla*, Lowe, 1854. *Aplostoma*, Moquin-Tandon, 1855. *Euhyalina*, Albers, 1857. *Hyalina* (restricted), Albers, 1860.) Shell convexly depressed or subdiscoidal, umbilicate, smooth, shining, pellucid, corneous, the base more or less milky opaque; aperture obliquely lunate; lip simple, acute. Mostly European. *H. glabra*, Stud.

ZONITOIDES, Lehm., 1864. *H. nitida*, Müll. Europe, United States.

NAUTILINUS, Mousson, 1872. Shell nautiloid, involute. *H. Clymene*, Shuttl.

CONULUS, Fitz., 1833. (Trochiscus, Held, 1837. Petasia, Beek, 1837.) Shell small, pellucid, corneous, globosely turbinated, or conic, thin, perforate or imperforate; aperture lunar, oblique; peristome simple. Universal, including several American and European species. *Z. fulvus*, Drap. (xciii, 98).

CONULOPOLITA, Böttger. No umbilicus as in Conulus. *H. Raddii*, Böttger. Caucasus.

GASTRODONTA, Albers, 1850. Shell subperforate or umbilicated, orbicularly depressed, light horn-color, sometimes glassy, with more or less numerous wrinkle-like striæ; whorls 5-7; aperture lunate, its base generally furnished with fold-like denticles not reaching its margin; peristome simple, acute. United States. *Z. interna*, Say (xciii, 100).

VENTRIDENS, Binney and Bland, 1869. Shell small, subperforated or umbilicated, orbicular, convex; aperture lunar, with revolving pliciform teeth within the base; peristome simple, sharp. *Z. gularis*, Say. *Z. suppressa*, Say. United States.

ODONTOSAGDA, Albers, 1860. Shell umbilicated, depressed, thin, white; whorls six, the last with convex base; aperture somewhat oblique, lunar, with three double lamellæ within; peristome acute, the columellar margin slightly reflexed. *Z. polyodon*, Weinland and Martens. Hayti.

PROSERPINULA, Albers, 1860. Shell scarcely perforated, discoidal, hyaline, transparent; whorls $4\frac{1}{2}$, planulate, the last slightly impressed at the base, with a shining callus around the perforation, spiral laminae reaching the margin; peristome acute. *H. discoidea*, Ads. 2 sp. Jamaica.

HELICODISCUS, Morse. Minute, planorboid, with revolving striæ, aperture lamellarly toothed within the outer lip. *Z. lineatus*, Say (xciii, 9, 10). United States.

MICROPHYSA, Albers, 1860. (Microconus, Strebel and Pfeffer.) Shell umbilicated, depressed, thin, striulate, scarcely shining; spire flattened with distinct suture; whorls 4-5, slightly convex, slowly increasing, the last not deflected; aperture rounded-lunate; peristome thin, the margin converging. *Z. Boothianus*, Pfr. (xciv, 15). 37 sp. West Indies.

PELLA, Albers, 1860. Shell umbilicate or imperforate, orbicular depressed, thin, striate or striately plicate; whorls five, slightly convex; aperture lunately rounded; peristome simple, acute; columellar lip dilated, reflected, free. *H. biscalpta*, Benson (xciv, 16). So. Africa.

SAGDINELLA, Mörch, 1872. Not characterized. *H. Didrichsenii*, Mörch. Nicobar Is.

STRIATURA, Morse, 1864. Central plate of the radula enormous; buccal lamina almost smooth, with a median furrow and notch. *Z. milium*, Morse. United States.

JANULUS, Lowe, 1852. Shell umbilicated, depressed orbicular,

costulately strigate above, rather smooth below; whorls 7-8½, closely revolving, the last convex at the base; aperture lunar; peristome simple, thin, with a callous ring within. *H. stephanophora*, Desh. (xciv, 13). Madeira.

ACTINARIA, Pfeiffer, 1855. Not characterized. 4 sp. India. *H. Pirrieana*, Pfr.

PUNCTUM, Morse, 1864. Buccal plate composed of sixteen distinct oblong laminae; the teeth of the radula are quadrangular plates with rather short denticles, similar to *Carychium*. Shell as in *Hyalina*. *H. minutissima*, Lea. United States.

MACROCYCLIS, Beck, 1837. Shell rather thin, widely umbilicated, depressed; the last whorl declining toward the aperture; aperture oval-rounded; peristome simple, sharp, the extremities approaching and the lower somewhat reflected. *Z. laxata*, Fer. (xciii, 93). Chili. 21 sp. California, Mexico, West Indies, Chili.

SELENITES, Fischer. Shell smaller, last whorl somewhat flattened above. Animal having the jaw of *Zonites* but the dentition of the *Testacellidæ*. North America. *Z. concavus*, Say (xciii, 94). Dr. Fischer has made this group the type of a family *Selenitidæ*, characterized by the peculiarities of jaw and dentition.

HAPLOTREMA, Ancey, 1881. Shell much smaller, peristome sharp. *Z. Duranti*, Newcomb.

MORCHIA, Albers, 1860. Shell widely umbilicated, depressed orbicular, rather thin, dark-colored, slightly striate, shining; whorls five; aperture semioval; peristome simple, acute; outer margin flexuous, columellar margin slightly thickened. *Z. concolor*, Fer. West Indies.

NANINA, Gray, 1834.

Distr.—503 sp. Universal, in tropical and subtropical regions of Asia, Africa and Oceanica.

Shell heliciform, perforated, dextral or sinistral, somewhat depressed, thin, polished, particularly inferiorly, rounded or carinated at the periphery; columellar lip short, reflected, often covering the umbilicus; outer lip simple or scarcely reflected.

Animal with two anterior mantle-lobes covering a part of the surface of the shell; foot long and narrow, posteriorly more or less truncated and glandular, the pore slit-like, sometimes surmounted by a horn-shaped protuberance. The mantle-lobes possess some power of lateral movement, and the faculty of expansion and retraction.

ARIOPHANTA, Desmoulins, 1833. Shell sinistral, umbilicated, thin, diaphanous, the last whorl sometimes angulated or carinated on the periphery. Animal similar to *Helix*, but having a very large tubercular caudal gland. *N. regalis*, Chemn. (xciii, 81).

Borneo. *N. lævipes*, Müll. (xciii, 86). Malabar. *N. Janus*, Chemn. (xciii, 87). Malacca.

OXYTES, Pfeiffer, 1855. Shell solid, obliquely striate or plicate, depressed, carinate, umbilicate; peristome expanded, thin, edentulous; columellar margin thickened. *N. oxytes*, Benson.

ROTULA, Albers, 1850. (*Pachystyla*, Mörch, 1852. *Trochomorpha*, Albers, partim.) Shell subperforated; spire depressed conical; last whorl carinated at the periphery; columella very short, vertical; lip simple. 19 sp. Mauritius, India, East Indies.

PACHYSTYLA, Mörch (restricted), 1852. *N. inversicolor*, Fer. (xciii, 89). Mauritius.

EREPTA, Albers, 1850. Shell with columellar tooth. *N. sty-lodon*, Pfr. (xciii, 90). Mauritius.

CÆLATURA, Martens. Shell spirally sculptured.

CALDWELLIA, H. Adams. Shell small, fragile, translucent, trochiform. *R. philyrina*, Morel.

RHYSOTA, Albers, 1850. Shell rugosely striated above, polished below; the last whorl depressed, dilated anteriorly, excavated around the umbilicus. *N. monozonalis*, Lam. (xciii, 85). Amboina.

TROCHONANINA, Mousson, 1869. (*Martensia*, Semper, 1870.) 12 sp. East Africa, East Indies, Polynesia. *N. Lychnia*, Gray (xciii, 88). Singapore.

ZINGIS, Martens. Shell heliciform, with a simple peristome; hinder extremity of the foot with mucous pore and a little prominence above it; jaw smooth, with median projection; marginal teeth of the radula bicuspidate. *N. radiolita*, Martens. Zanzibar.

EUPLECTA, Semper. Shell striated or ribbed above. Cervical lobes of the mantle developed, the left subdivided into two; shell-lobes rudimentary. 9 sp. Philippines. *N. Boholensis*, Pfr.

ORPIELLA, Gray, 1855. Shell thin, rounded, depressed, with four-and-a-half convex whorls, the last somewhat flattened basally. Animal with the anal lappet of *Nanina* covering the mucous pore, and six other smaller ones between this and the shell, arranged in a double series along the back of the tail. *N. scorpio*, Gould. Fiji Islands.

XESTA, Albers, 1850. (*Xestina*, Pfeiffer.) Shell perforate or narrowly umbilicate, orbicularly depressed, smooth, usually polished; aperture large, rounded ovate; margin acute; columellar margin dilated and reflexed. *N. citrina*, Linn. (xciii, 80). Moluccas.

BENSONIA, Pfeiffer, 1855. Not characterized. *N. splendens*, Hutton.

MACROCHLAMYS, Benson, 1832. (*Tanychlamys*, Benson, 1834.) Limited by Semper to the species of *Nanina*, the shells of which

are depressed globose, pellucid or corneous, smooth and shining both on the upper and under surface. Two long tongue-shaped shell-lobes; the left cervical lobe divided into two. *N. spectabilis*, Pfr.

EURYPIUS, Semper, 1870. Foot with the back broad, not carinated. *N. casca*, Gould. Fiji Isles.

ROTULARIA, Mörch, 1872. Uncharacterized. *N. Reinhardi*, Mörch. Nicobar Isles.

GERONTIA, Hutton, 1883. Shell depressed, umbilicated, of about five gradually increasing whorls, aperture oblique, margin not reflected, thin. Animal heliciform; mantle rather posterior, included; tail acute, with a mucous pore, but no papilla. Jaw smooth, striated. *H. pantherina*, Hutton. New Zealand. Differs from *Patula* in having a mucous pore.

MEDYLA, Gray, 1855. (*Otesia*, H. and A. Adams, 1855.) Shell imperforate or scarcely rimate, depressed, thin; whorls few, rapidly increasing, the last rounded or carinate; aperture large, angulately lunar; lip simple, acute. *N. tecta*, Soul.

AMPHIDOKA, Albers, 1850. Shell perforated, depressed, thin, pellucid; whorls convex, rapidly increasing; aperture very oblique, large, oval; peristome simple, its extremities connected by a very thin callus. *N. marmorella*, Pfr. 2 sp. Juan Fernandez.

MICROCYSTIS, Beck, 1837. (*Helicopsis*, Beck, 1837. ? *Platycloster*, Hasselt.) Shell small, subperforated, glabrous; aperture large, subvertical. *N. Adamsi*, Pfr. (xciii, 83). Pitcairn's Isl.

MICROCYSTINA, Mörch. Shell polished, with a small notch at the pillar-lip. *N. Rinki*, Mörch. Nicobar Is.

SESSARA, Albers, 1860. Shell imperforate, depressly orbicular, costulate-striate above, angulate on the periphery; base smooth, excavated; aperture depressed, wide, toothed. *N. infrendens*, Gould. Distinguished from other *Naninae* by the thickened columellar lip and toothed aperture; mantle-lobes small. Jaw smooth, finely radiate-striate on the inner side, with an obtuse middle projection.

THALASSIA, Albers, 1860. Shell imperforate or scarcely perforate, conic-orbicular, thin, pellucid; whorls five or six, slowly increasing, the last angulate or carinate, umbilical region impressed; peristome simple, acute; columellar margin slightly reflexed. *N. subrugata*, Pfr.

SOPHINA, Benson, 1859. Foot long, obliquely truncate at its posterior end, with a large gland and distinct horn-like appendage; mantle-lobes as large as in *Helicarion*. Shell with a callous columella, angulated at the basal margin, and with a more or less acute umbilical carina. *N. Calias*, Benson.

HEMIPLECTA, Albers, 1850. Shell granulose or striated above, polished below; last whorl more or less angular or carinated

at the periphery. *N. conoidalis*, Ad. and Reeve (xciii, 84). Philippines.

THAPSIA, Albers, 1860. Shell orbicularly depressed, thin, pellucid, undulately decussated, narrowly perforated; whorls six, slowly increasing; peristome simple, acute; columellar margin narrowly reflected. *N. troglodytes*, Morelet.

FAMILY HELICIDÆ.

Shell spiral, usually thicker than in the Zonitidæ, and mostly with reflected lip, the aperture edentulous or contracted by teeth.

Animal capable of complete retraction within the shell; the jaw finely striate, or ribbed, sulcate or plicate; teeth, central tricuspid, laterals bicuspid or tricuspid with an obsolete internal cusp, marginals usually wider than high, short, with two or three small cusps (xiii, 59).

HELIX, Linnaeus.

Distr.—3400 sp. Universal. Fossil; Cretaceous—. Europe; Laramie—. U. S.

Shell of variable form, smooth, rugose, striate, ribbed or tuberculate, sometimes pilose; orbicular convex, planorboid, trochiform, subturriculated, or short bulimiform (monstrosities sinistral, or with the whorls more or less uncoiled); aperture oblique, oval, or semilunar, with or without interior teeth on the margin or parietal wall; lip simple or thickened internally or reflected; umbilicus covered to widely open.

No precise diagnosis can be given of a genus in which the characters of the shell vary so much as in *Helix*. Albers, Beck, Swainson, Ferussac, H. and A. Adams, etc., have proposed a great number of groups, the species of which possess usually the double value of similar characters coinciding with similar distribution. Thus the species of a subgenus or section of *Helix* very generally strongly suggest by their facies and territory their descent from a common ancestry.

The number of species of *Helix*, although reduced by the elimination of the genera *Nanina* and *Zonites*, is still so large that a further separation would be very desirable; such groups as *Patula*, *Sagda*, etc., could be used in a generic sense with great advantage, provided conchologists would cease to apply to them the familiar designation *Helix*.

SAGDA, Beck, 1837. (*Epistylia*, Swainson, 1840.) Shell not umbilicated, globosely conoidal; spire more or less elevated, with obtuse apex; eight or nine whorls, the last flattened at the base, excavated around the umbilical region, with internal revolving lamellæ; columella short, oblique, dilated at the base; aperture obliquely semilunar; peristome simple. Jaw oxygnathous. 13 sp. Jamaica. *H. alligans*, Ads. (xciii, 2).

Hyalosagda, Albers, 1860. Shell scarcely perforated, depressed hyaline, thin; whorls 5-7, the last excavated at the base; aperture obliquely lunar; peristome acute, columellar margin scarcely dilated, slightly reflexed. *H. similis*, Adams. Jamaica.

PATULA, Held, 1837. (*Euryomphala*, Beck, 1837. *Delomphalus*, Agassiz, 1837. *Euryomphala*, Herm., 1846. *Discus* [part], Ads., 1855.) Shell perspectively umbilicated, discoidal or turbinated, depressed, rugose or striated; whorls gradually enlarging; aperture rounded, unarmed by teeth; lip simple, sharp. Jaw smooth or slightly striated, with a more or less marked median projection. 327 sp. Universal.

Pyramidula, Fitz., 1833. *H. rupestris*, Drap. Europe.

Patulastra, Pfeiffer, 1878. Uncharacterized. *H. ampla*, Pfr. Mexico.

Discus, Fitz., 1833. *H. perspectiva*, Say. United States. *H. rotundata*, Müll. (xciii, 6). Europe.

Planogyra, Morse, 1864. Shell minute, perfectly flat above, umbilicus moderate; whorls very convex, the last one sharply ribbed. *H. asteriscus*, Morse (xciii, 7). United States.

Gonyodiscus, Fitz., 1833. *H. solaris*, Menke. Europe.

Acanthinula, Beck, 1846. (*Zoogenites*, Morse, 1864.) Shell perforated, globosely turbinated, with a brownish plicately ribbed or aculeate epidermis; whorls 4-5; aperture rounded; peristome thin, somewhat expanded, its extremities approaching. *H. harpa*, Say (xciii, 99). *H. aculeata*, Müll. (xciv, 40). 8 sp. United States, West Indies, Europe. Buccal plate transversely and longitudinally striate, its edge slightly indented with a middle projection. Viviparous, containing embryos in various stages of development at the same time.

Trichodiscus, Strebel and Pfeffer. Shell subdepressed, widely umbilicated, banded, beset with fine bristle-bearing warts; peristome shortly reflected. *H. coactiliata*, Fer. Mexico.

Thysanophora, Strebel and Pfeffer. Shell flat or conical, widely umbilicated, brown, with longitudinal plaits and rows of epidermal fringes; aperture simple. *H. impura*, Pfr. Mexico.

Lyra, Shuttlew. Shell with revolving lines. Canaries.

Patulopsis, Strebel and Pfeffer. Shell nearly flat, keeled, ribbed, with wide umbilicus. *H. carinata*, S. and P. Mexico.

Pseudohyalina, Morse, 1864. (*Chanomphalus*, Strebel and Pfeffer.) Distinguished from *Patula* by the minute size and more moderate umbilicus. *P. minuscula*, Say, etc. United States, Mexico, etc.

Anguipira, Morse, 1864. Shell large, depressed turbinated, banded or striped; umbilicus moderate. *P. alternata*, Say (xciii, 8). United States.

Stephanoda, Albers, 1860. Shell widely umbilicated, thin, depressed, plane above, convex below, with 5-7 close volutions,

and impressed sutures; last whorl narrow, not descending in front; aperture slightly oblique, rounded-lunate; peristome simple, acute, margins joined. *H. dissimilis*, Orb. South America.

Macrocycloides, Martens, 1867. Shell depressed, almost planorboid, shining, striate, hyaline, base slightly excavated, showing all the whorls; peristome acute, the margins slightly approaching. *H. obscurata*, Ad. and Reeve. 3 sp. East Indies.

Pitys, Beck, 1837. (Endodonta, Albers, 1850.) Shell small or minute, corneous, frequently with longitudinal brown bands, umbilicated or rarely subperforated; conical, orbicular, depressed or discoidal; aperture lunar, angular, very rarely rounded, with lamellar teeth upon the interior or parietal walls, or both; peristome simple, sharp. 56 sp. Polynesia. *H. lamellosa*, Fer. *H. contorta*, Fer. (xciv, 11). Sandwich Islands.

Libera, Garrett, 1881. Shell small, widely umbilicated, umbilicus (in adults) strongly constricted, so as to form a cavernous or pouch-like cavity; whorls 7-9, costulate or striate, last one angulate or carinate, rarely rounded; peristome simple; parietal region with one or two, and the palate with two or three internal laminae; columella emarginate and furnished with a spiral fold. Polynesia. *H. fratercula*, Pease. Remarkable for their singular habit of ovipositing into their cavernous umbilicus—the constriction of which does not occur until the last two whorls are completed. Sometimes a temporary shelly plate retains the eggs or young within the umbilicus.

Laoma, Gray, 1849. Shell turreted, conical, scarcely perforated, smooth, pellucid, shining; whorls seven, flattened, the last carinated, base plane; aperture square depressed, lamellate; lip simple. *H. leimonias*, Gray. 2 sp.

Charopa, Albers, 1860. Shell thin, depressed, rarely conical, umbilicated, with transverse ribs, sparsely bristly; whorls 4-5½, the last not deflected in front; aperture slightly oblique, lunately rounded; peristome simple, margins joined. *H. coma*, Gray (xciv, 12); New Zealand. 48 sp.; Australasia.

Trochomorpha, Albers, 1850. (Geotrochus, Van Hasselt.) Shell umbilicated or subperforated, trochiform, the apex more or less obtuse; whorls somewhat flattened, the last with a carinated periphery; aperture depressed, oblique; peristome simple; columellar lip rarely thickened or dentate. 165 sp. India, East Indies, Polynesia.

Nigritella, Albers, 1860. Depressed trochiform, umbilicated, striate, shining, dark brown or blackish; whorls 7-8, the last plane or excavated beneath; aperture depressed, oblique, semi-oval or elliptical; peristome simple, thickened, outer margin flexuous, columellar margin callous. *H. nigritella*, Fer. *H. Pagodula*, Pfr. (xciii, 4).

Thysanota, Albers, 1860. Narrowly umbilicate, trochiform, thin; whorls $7\frac{1}{2}$, scarcely convex, base carinated, with rigid hairs; aperture angularly lunar; lip simple, acute; columellar margin slightly expanded. *H. Guerini*, Pfr. 5 sp. India.

Kaliella, Blanford, 1863. Uncharacterized. *H. Barrak-porensis*, Pfr. 3 sp. India.

Videna, H. and A. Adams, 1852. (Discus, Albers, 1850.) Shell widely umbilicated, thin, discoidal, carinated at the periphery, flat or somewhat elevated above, convex below; aperture subtriangular; peristome simple, sharp or slightly thickened. 75 sp. Mostly Polynesian and Australasian. *H. acutimargo*, Pfr. Philippines (xciii, 5).

Sitala, A. Ad., 1856. (Conulema, Stoliczka.) Shell conoid, thin, consisting of many whorls, usually spirally ribbed or striated; base convex, narrowly or indistinctly umbilicated; margin of aperture thin, not expanded, outer margin simple. Animal narrow, long; gland at the end of the foot, beneath a distinct horn; two shell-lobes and two dorsal lobes on the mantle, all of them small and with no separately produced appendages; jaw thin, smooth, indistinctly concentrically striated in the middle. 7 sp. Southern Asia. *H. ategia*, Benson.

GLYPTOSTOMA, Bland and Binney, 1873. Shell widely umbilicated, depressed, with wrinkle-like striæ, solid; whorls six, the last depressed globose, not reflected at the aperture; aperture oblique, subcircular; peristome simple, acute, thickened within, its extremities approaching; columellar lip scarcely reflected. Jaw imbricated; no mucous pore. The animal a true Helix, although the shell has some resemblance to the Zonitidæ. *Z. Newberryanus*, Binney (xciv, 14). California.

PHRIXGNATHUS, Hutton, 1883. Shell conical or turbinated, of five or six gradually increasing whorls; peristome thin, not reflected. Animal heliciform; mantle subcentral, reflected anteriorly over the shell; foot without locomotive disk, rounded posteriorly, without mucous gland. Jaw papillate, imbricately folded; teeth quadrate, the laterals bicuspid. *H. marginata*, Hutton. N. Zealand.

CARACOLUS, Montfort, 1810. (Discodoma, Sw., 1840, Serpentinulus, Klein, Adams, 1855.) Shell solid, orbicularly depressed, carinated, flattened at base, umbilicated or imperforate; last whorl deflected at the aperture; aperture oblong, subangular, peristome thickened, reflected, widened below the columella, which extends to or covers the umbilicus. *H. caracolla*, Fer. (i, 16, scalariform). 16 sp. West Indies.

Polydontes, Montfort, 1810. Imperforate, globosely depressed, or conoidally globose, solid, striate; spire hardly elevated, conoidal, apex obtuse; whorls $5-5\frac{1}{2}$, slightly convex; the last large,

angulate, slightly descending in front; columella inclining, wide; aperture truncate ovate; peristome thickened, sometimes callously tuberculated, shortly reflected, patulous, basal margin callously dilated. *H. imperator*, Montf. (xcvi, 84). 5 sp. Cuba, Porto Rico.

Dentellaria, Schum., 1817. (*Lucidula*, *Cyclodoma*, Swn., 1840.) Shell imperforate, very rarely umbilicated, solid, depressed or conical globose; spire obtuse; last whorl deflected in front, mostly angular at the periphery; aperture oblique or subhorizontal, transverse; peristome thick, dentate or tuberculate within, its extremities joined by a heavy parietal callus. *H. Josephinæ*, Fer. (xcv, 72). 18 sp. West Indies, South America.

Pleurodonta, Fischer, 1807. (*Caprinus*, Montf., 1810. *Lyrostoma*, Mörch, 1852. *Lucernella*, Swn., 1840.) Shell orbicular, conoidal or lenticular, imperforate, or umbilicus covered; whorls five or six, flattened, the last carinated or angulated; aperture elliptical, oblique, nearly horizontal; peristome thick, subtrapezoidal, the extremities joined by a thickened callus, lower lip dilated, reflected, dentate within, with opposite exterior pits. *H. lucerna*, Müller. *H. soror*, Fer. (xcvi, 85). 35 sp. Jamaica.

Labyrinthus, Beck, 1837. (*Lyrostoma*, Swn., 1840.) Shell umbilicated, depressed orbicular, convex above and below; whorls five or six, the last carinated, depressed at the aperture; aperture nearly horizontal, auricular, grimacing, lamellated and dentate within; peristome thick, reflected, the extremities approaching, and continued subparallel into the umbilicus. *H. labyrinthus*, Chemn. (xcvi, 86). 22 sp. Central and South America.

Cepolis, Montfort, 1810. Shell umbilicated or partly covered, globosely depressed; whorls $4\frac{1}{2}$ -5, the last suddenly deflected at the aperture, gibbous, scrobiculate or sulcate, tuberculate or plicately callous within; aperture elongate-lunate, peristome more or less expanded, the basal margin dilated, reflected, dentate or callous. *H. cepa*, Müll. 9 sp. Hayti, Porto Rico, Nicaragua, Java, China.

Isomeria, Albers, 1850. Shell umbilicated, depressed orbicular; last whorl obtusely angulated on the periphery, rounded in front, deviating near the aperture, ventricose at base, and contracted around the umbilicus; aperture oblique, semioval, with two interior teeth, one at the periphery, the other upon the opposite parietal wall; peristome thickened, reflected. *H. oreas*, Koch (xcvi, 87). 23 sp. Northern South America.

SOLAROPSIS, Beck, 1837. (*Solarium*, Spix, 1827. *Ophiodermis*, Agassiz, 1837.) Shell umbilicated, orbicularly depressed, flattened, conical above, convex below; last whorl obtusely carinated and peculiarly constricted at the periphery; aperture obliquely semilunar; peristome labiate, reflected; columellar lip

dilated. Jaw oxygnathous. *H. pellis-serpentis*, Chemn. (xcvi, 93). 26 sp. South America.

Psadara, Miller. Smaller and thinner, hairy, not keeled. 6 sp. So. America.

GONOSTOMA, Held, 1837. (Anchistoma, Kobelt, 1871.) Shell umbilicated, orbicularly depressed, with close volutions, often with fugacious hairs; whorls 5-7, slowly increasing, the last angulate or acutely carinate above; aperture oblique, narrowly lunar, often sinuate; peristome labiate, reflected, sometimes callous; parietal wall unarmed. Jaw odontognathous.

Drepanostoma, Porro, 1836. Shell discoidal, planorbiform, the last whorl nearly covering the previous ones, so that the axis is concave above and below; profoundly umbilicated; aperture subvertical; the outer lip reflected. *H. nautiliformis*, Porro (xciv, 19, 20). Italy.

Trigonostoma, Fitz., 1833. (Helicodonta, Risso, 1826. Vortex, Beck, 1837. Euphemia, Leach, 1846.) Typical group. *H. holosericea*, Studer (xciv, 21). 5 sp. Europe.

Caracolina, Ehr., 1831. (Caracollina, Beck, 1837.) *H. lenticula*, Fer. (xciv, 22). 25 sp. Mediterranean region, Madeira, etc.

Sculptaria, Pfeiffer, 1855. Uncharacterized. *H. sculpturata*, Gray. 2 sp. W. Africa.

Ophiogyræ, Albers, 1850. Shell discoidal, many-whorled, plane above, concave below, showing all the whorls on either side; aperture very oblique, rounded; peristome slightly reflected, its extremities connected by a parietal callus.

Polygyratia, Gray, 1847. *H. polygyrata*, Born (xciv, 23). Brazil.

Systrophia, Pfeiffer, 1855. 15 sp. Central and South America. *H. helicycloides*, Orb.

CORILLA, Adams, 1855. (Atopa [part], Albers.) Often sinistral, widely umbilicated, discoidal, plane above, convex at base; last whorl compressed at the side, anteriorly deflected; peristome thickened, reflected, the margins joined by an elevated callus emitting a strong re-entering lamina. *H. Rivolii*, Desh. (xciv, 24). 8 sp. India, etc.

Stegodera, Martens, 1876. Shell like Corilla, but without parietal plica. *H. angusticollis*, Martens. China.

Plectopylis, Benson, 1860. Shell usually sinistral, subdiscoidal, widely umbilicated; parietal wall with a horizontal plica or ridge; several ridges within the aperture at irregular intervals, the first of them more or less remote. *H. leiophis*, Benson (xciv, 25). 24 sp. India, Burmah.

ÆGISTA, Albers, 1850. Shell widely and profoundly umbilicated; spire depressed conic; whorls slowly enlarging, the last well rounded; aperture small, oblique, subcircular; peristome

sublabiate, reflected, its extremities approaching. 6 sp. E. Asia.
H. oculus, Pfr.

POLYGYRA, Say, 1817. Shell planorboid, many-whorled, whorls narrow, ribbed above, periphery angulate; aperture small, trigonal, with a V-shaped parietal tooth, joined by a raised callus to the extremities of the lip, but no lip-teeth; below plane, showing several whorls, with a narrow umbilicus; horn-color. *H. septemvolva*, Say (xciv, 26, 27). 22 sp. Southern United States, Mexico, West Indies, So. America.

Dædalochila, Beck, 1837. Shell small, depressed, ribbed-striate, periphery angulate, below convex, showing more than one, sometimes two whorls, with a minute central perforation; lip auricular, with internal teeth, marked externally by scrobiculations; parietal wall with a V-shaped tooth, callously joined to the extremities of the lip. *H. auriculata*, Say (xciv, 28, 29). 22 sp. Southern United States, Mexico, W. Indies, etc.

Polygyrella, Bland. (Adelodonta, Ancy.) Shell discoidal, ribbed above; two rows of three teeth within the last whorl; peristome thickened, simple, margins joined by a pliciform elevated triangular plate. *H. polygyrella*, Bland (xciv, 30, 31). Washington Terr., U. S.

Ammonitella, Cooper. Each whorl largely enclosed by its successor, so that the spire forms a crateriform depression; aperture vertically narrow; peristome obtuse, thickened; umbilicus large. *A. Yatesii*, Cooper (xciv, 32, 33). California.

STENOTREMA, Raf., 1819. (*Stenostoma*, Raf., 1831.) Shell small, often hirsute; aperture narrowly transverse, basal, extending from the periphery to the axis of the shell; parietal wall with a long lamellar tooth, lip broad, with generally a notch in the centre. Within the aperture, and near the axis, may be seen an accessory column or pillar, probably assisting the animal in retiring within its shell. *H. hirsula*, Say (xciv, 34). 10 sp. United States, mostly east of the Rocky Mountains.

TRIODOPSIS, Raf., 1819. Shell globosely depressed, umbilicate; aperture trilobate, caused by denticles on the superior and inferior parts of the lip and on the parietal wall. *H. tridentata*, Say (xciv, 35). 8 sp. United States.

Xolotrema, Raf., 1819. Shell turbinate or depressed, frequently angulate or carinate on the periphery; base convex, imperforate; aperture trigonal; lip with a long lamellar tooth at the base, and frequently a small superior tooth; parietal wall with a large curved lamellar parietal tooth. *H. palliata*, Say (xciv, 36). 3 sp. United States.

Isoptomostoma, Fitz., 1833. (*Helicodonta*, Moquin-Tandon, 1855.) Shell small, globosely depressed, umbilicus covered by the extremity of the lip; aperture tridentate, the two lip-teeth small, the parietal tooth larger, blade-shaped. Horn-color, fre-

quently hirsute. *H. personata*, Lam. (xciv, 37). 4 sp. United States, Europe.

MESODON, Raf., 1831. (Patera, Albers, 1850.) Shell umbilicated or imperforate, depressed globose, striate or costulate; last whorl deflected near the aperture; peristome reflected, white; parietal wall usually obliquely dentate. Shell usually corneous, without bands. *M. albolabris*, Say (xciv, 38). *H. multilineata*, Say, has revolving brown bands, which sometimes coalesce into a uniform brown. 20 sp. United States.

Ulostoma, Albers, 1850. Shell large, umbilicated, globosely depressed; aperture semicircular; lip reflected, tuberculately toothed at the base; sometimes with also a small parietal tooth. *H. profunda*, Say (xciv, 39). 2 sp. United States.

STROBILA, Morse, 1864. Shell minute, umbilicated, globosely conic or depressed, obliquely and coarsely striated, smoother below; whorls 5-6, the last globose; aperture lunately rounded, peristome thickened and reflected; the parietal wall and base of last whorl each with two or more revolving lamellæ. Animal with thick, bulbous tentacles, and large eyes. *H. labyrinthica*, Say (xciv, 18). 4 sp. United States, Mexico, West Indies.

THELIDOMUS, Swainson, 1840. Shell imperforate or very rarely umbilicated, solid, globosely depressed; spire short, obtuse; whorls four or five, the last contracted and deflected at the aperture, gibbous, obtusely angular on the periphery; aperture transversely oval; peristome very thick, reflected, the extremities connected by a wide callus, basal portion of lip often callously tuberculate or denticulate within. 21 sp. West Indies. *H. (Pachystoma) Guantanamensis*, Poey (xevi, 77).

Leiocheila, Albers, 1850. (*Leiostoma*, Swainson, 1840.) Shell imperforate, subglobular, rather solid; spire short, obtuse, whorls three-and-a-half, the last very large, ventricose; aperture large, obliquely rounded; columella arcuated, widely callous; lip callously thickened. *H. Jamaicensis*, Chemn. (xevi, 78). Jamaica.

Pachystoma, Albers, 1850. (*Otala*, Mörch, 1852.) Imperforate, very rarely narrowly umbilicate, solid, depressly globose; spire short, obtuse; whorls 4-5, the last protracted at the aperture, gibbous; sometimes obtusely angulated; peristome thick, the margins callously connected, base callous or denticulate. *H. auricoma*, Fer. Mostly Cuban.

Eurycratera, Beck, 1837. (*Parthena*, Albers, 1850, part.) Shell umbilicated or imperforate, rather thin, ventricose, obliquely oval; whorls few, very rapidly increasing, the last greatly developed; aperture oblong, oblique; peristome simple or slightly expanded below, the lips united by a thin callus; columellar lip narrowly reflected. *H. obliterated*, Fer. (xevi, 81). 20 sp. Hayti.

Coryda, Albers, 1850. Shell imperforate, globosely conic or depressed; whorls five and a half, the last anteriorly deflected,

and excavated around the columella; aperture obliquely oval; peristome thickened within; columella much dilated and appressed. *H. alauda*, Fer. Cuba.

Histrio, Pfeiffer, 1854. Uncharacterized. *H. Dennisoni*, Pfr. Cuba.

Jeanneretia, Pfeiffer, 1877. Uncharacterized. *H. Parraiana*, d'Orb. 7 sp. Cuba, Porto Rico.

Dialeuca, Albers. Imperforate, turbinately globose; five whorls, the last obtusely angulate; aperture obliquely rounded; peristome simple, sharp; columella intrant, oblique, wide, flattened above. *H. nemoraloides*, C. B. Ad. (xcv, 65). Jamaica.

OXYCHONA, Mörch, 1852. Imperforated, trochiform; last whorl carinated with flattened base; peristome simple, sharp, outer lip inflected in the middle, columellar lip thickened. *H. bifasciata*, Burrow (xcv, 74). Brazil.

POLYMITA, Beck, 1837. (Phædra [pt.], Albers, 1850.) Shell imperforate or perforated, globular, shining; spire small and short; whorls four or five, the last very large and rounded; aperture rounded; peristome simple, obtuse, the extremities joined by a transparent callus; columella oblique, widely dilated above. *H. picta*, Born (xcvi, 80); Cuba. 5 sp. Cuba.

Cysticopsis, Mörch, 1852. (Parthena, Albers, 1850, *partim*.) Shell imperforate, globose, shining; whorls convex, the last ventricose; aperture large, rounded; columella short, vertical, a little dilated above; peristome simple. *H. Cubensis*, Pfeiffer. (xciv, 17). 20 sp. West Indies.

Praticola, Strebel and Pfeffer. Shell globular, irregularly plaited, aperture expanded, thickened internally, concealing a part of the narrow umbilicus. Mexico. *H. griseola*, Pfr., and *H. Berlandieriana*, Moric., are examples.

Pelia, Albers, 1860. Shell imperforate, depressed, lenticular, thin, with concentric lineated lines, acutely carinate; whorls five, slightly convex, the last with convex base, impressed in the middle; aperture subrhombic; peristome simple, acute. *H. spirulata*, Pfeiffer. Central America.

Plagioptychia, Pfr., 1855. Umbilicus narrow or covered, depressed suborbicular, thin, small, spire scarcely elevated, obtuse; whorls four-and-a-half, the last suddenly deflected and constricted at the aperture; aperture subhorizontal, elongate-lunate; peristome thin, margins approaching, the basal with a dentiform plica. *H. loxodon*, Pfr. (xcv, 70). 19 sp. Hayti, Bahamas, etc.

Hemitrochus, Swainson, 1840. (Phædra [pt.], Albers, 1850.) Shell imperforate or perforate, globose, shining, spire short, whorls 4-5, the last large, deflected at the aperture; aperture contracted, subvertical, rounded-lunate; peristome simple,

obtuse, margin callous, labiate within. *H. varians*, Menke (xcvi, 79). 21 sp. West Indies, Bahamas.

Leptoloma, Albers, 1860. (Dialeuca, Pfr., 1855.) Imperforated, depressly turbinate, base planulate; whorls five, the last obtusely angulate; aperture obliquely lunar; peristome acute, shortly expanded; columellar entering, dilated above, oblique. *H. fusco-cincta*, Ads. (xcv, 64). 11 sp. Jamaica, Cuba, Central America.

LEUCOCHROA, Beck, 1837. (Solarium, Schum., 1817. Calcarina, Moquin-Tandon, 1848. Iberus, H. and A. Adams [part], 1855.) Shell openly or narrowly umbilicated, globose or depressly globose, solid, cretaceous; whorls about five, the upper ones carinate, the last slightly descending in front; aperture lunately rounded; peristome simple, labiate or thickened within, margins joined by a thin callus; columella callously dilated, narrowing the umbilicus in the adult. *L. candidissima*, Drap. (xciii, 3). 17 sp. Mediterranean region.

HELICELLA, Fer., 1819. Shell generally umbilicated; peristome simple or labiate within, rarely dentate. Jaw odontognathous or aulacognathous. Distribution universal. *H. ericetorum*, Müll. (xcv, 48).

Hygromia, Risso, 1826. (Helicella, Fitz., 1833. Bradybæna, Beck, 1837.) Shell umbilicated or perforated, globosely depressed, corneous, sometimes hirsute; peristome sharp, labiate within, slightly reflected at the base. 200 sp. Universal; largely European. *H. hispida*, Müll. (xciv, 44).

Hispidella, Lowe, 1852. *H. nubigena*, Lowe. Canary Islands.

Ciliella, Mousson, 1872. *H. leprosa*, Shutt. 2 sp. Canary Islands.

Xerophila, Held, 1837. (Oxychilus, Fitz., 1833. Theba, Risso, 1826.) Shell perforated or umbilicated, turbinate or globosely depressed, rarely conic-orbicular, calcareous with corneous apex, shining; whorls five or six, gradually enlarging; aperture subcircular; peristome simple, labiate within. 200 sp. *H. ericetorum*, Müll.

Euparypha, Hartmann, 1840. Shell perforate, depressly globose, horny calcareous, filleted; whorls five, the upper ones flattened, carinate, the last inflated; aperture lunar, labiate within, columellar margin reflected. *H. Pisana*, Müll. (xciv, 46). Mostly European.

Heliomanes, Fer., 1819. Shell globose. Mediterranean region. *H. variabilis*, Drap.

Pseudoxerophila, Westerlund. Shell with fine spiral striæ and rows of punctiform impressions. *H. instabilis*, Ziegler, etc.

Monilearia, Mousson, 1872. 11 sp. Canary Islands. *H. phalerata*, Webb and Bertholet.

Lemniscia, Lowe, 1854. *H. Michaudi*, Desh. Porto Sancto.

Jacosta, Gray, 1821. (Crenea [pt.], Albers, 1850.) Shell

carinate. 28 sp. Mediterranean region. *H. flimargo*, Ziegler (xciv, 47).

Xeroleuca, Kobelt, 1877. Shell peculiarly sculptured; without markings. 4 sp. Northern Africa. *H. Mograbina*, Mor.

Helicopsis, Fitz., 1833. (*Candidula*, Kobelt, 1871.) 40 sp. Mostly Europe and Syria. *H. striata*, Drap.

Turricula, Beck, 1837. (*Obelus*, Hartmann, 1840. *Crenea* [pt.], Albers, 1850.) Shell conical, perforate or umbilicate, usually costulate, last whorl more or less angulated at the periphery. *H. pyramidata*, Drap. (xcvi, 49). 38 sp. S. Europe, N. Africa, Syria, etc.

Cochlicella, Risso, 1826. (*Elisma*, Leach, 1840. *Longæva*, Muhlf.) Shell narrowly perforate, turreted-conical, white, fasciate; whorls 6-9, the last usually subangulate; aperture rounded-oval; peristome simple, acute, the margins approaching. *H. acuta*, Müll. 9 sp. Southern Europe, etc.

OCHTIEPHILA, Beck, 1837. Shell umbilicated or perforated, trochiform or subdiscoidal, striate, ribbed or granulate; whorls 4-8, the last carinated or angulated, deflected near the aperture; aperture circular or subcircular; peristome continuous, the extremities joined by a ridged callus, more or less thickened, a little reflected. 23 sp. Canary Islands, Madeira.

Hystericella, Lowe, 1854. Shell conuloid or trochiform. *H. bicarinata*, Lowe (xcv, 50). Madeira.

Geomitra, Swains., 1840. (*Coronaria*, Lowe, 1854.) Shell mammillate. *H. coronata*, Desh.

Heterostoma, Hartmann, 1844. (*Spirorbula*, Lowe, 1854.) Shell planorbiform. *H. paupercula*, Lowe.

Irus, Lowe, 1854. (*Placentula*, Pfr., 1855.) Shell turbinate depressed. *H. depauperata*, Lowe.

Placentula, Lowe, 1854. Shell discoidally depressed. *H. Maderensis*, Wood.

Actinella, Lowe, 1854. (*Rimula*, Lowe, 1854. *Caseolus*, Lowe, 1854.) Shell narrowly umbilicated or subperforated, globosely depressed; the last whorl more or less carinated or angulated, slightly deflected in front; aperture oblique; peristome simple, plaited within; lip reflected at the base, its extremities more or less approaching and connected by a callus. 18 sp. Madeira. *H. compacta*, Lowe.

Tectula, Lowe, 1854. Shell umbilicate or narrowly perforate, depressed pyramidal, scabrously granulate; last whorl carinate; peristome simple, callously labiate within, the approximating margins joined by a thin callus. *H. Bulweri*, Wood. 3 sp. Madeira.

Craspedaria, Lowe, 1854. Shell with revolving ribs. *H. delphinula*, Lowe. 2 sp. Madeira.

Discula, Lowe, 1854. Shell like *Tectula*, but depressed. *H. polymorpha*, Lowe. 20 sp. Madeira.

Callina, Lowe, 1854. *H. rotula*, Lowe. Porto Sancto.

PLECTOTROPIS, Albers, 1860. (Thea, Albers, 1850.) Shell openly and profoundly umbilicate; lenticular, thin, diaphanous, carinate; whorls six-and-a-half, slowly increasing, the last not descending; carina acute, compressed, crenulate; aperture securiform or subrhomboidal; upper margin of peristome thin, somewhat expanded, basal margin scarcely dilated, shortly reflected. 38 sp. Eastern Asia, Australia. *H. elegantissima*, Pfr. (xcv, 51).

VALLONIA, Risso, 1826. (Circinaria, Beck, 1837. Lucena, Moquin-Tandon, 1855. Corneola, Held, 1837. Chilostoma, Fitz., 1833. Glaphyra, Albers, 1850. Amplexus, Brown, 1827. Zurama, Leach, 1820.) Shell somewhat depressed, diaphanous, umbilicated; whorls three or four, rounded; aperture oblique, subcircular; peristome with white reflected lip, its extremities joined by a parietal callus. Species all minute. *H. pulchella*, Müller (xciv, 41, 42), inhabits the northern regions of both hemispheres, and is a common shell throughout the northern United States and British America; unlike the essentially American forms it seems to prefer open gardens to damp woodlands, thus betraying its European origin. *H. pulchella*, Müll. 4 sp. Europe, United States, Australia.

PETASIA, Beck, 1837. (Trochiscus, Held, 1837. Perforatella, Schlüter, 1838. Dibothrion, Pfr., 1855.) Shell thin, narrowly perforated, turbinate-globose, closely wound; whorls 6-8, the last not deflected; aperture obliquely lunate; peristome labiate within, patulous or subreflected, basal margin dentate. *H. bidens*, Chemn. (xciv, 43). 2 sp. Europe, Siberia.

FRUTICICOLA, Held, 1837. (Helicella, Stabile, 1864.) Shell umbilicate or perforate, depressly globose, sometimes hairy; whorls 5-6, somewhat convex; aperture widely lunar or lunately rounded; peristome acute, slightly expanded, labiate within, basal margin reflected. *H. fruticum*, Müll.

Monacha, Hartmann, 1840. Shell conical, perforate; peristome labiate and reflected. *H. incarnata*, Müll.

Nummulina, Kobelt, 1871. *H. nummus*, Ehrenberg (xciv, 45). 5 sp. Syria, etc.

Carthusiana, Kobelt, 1871. (Teba, Strobel, 1850. Theba, Stabile, 1864.) *H. carthusiana*, Müll. European.

Zenobia, Gray, 1821. Shell conoidal, perforate, peristome simple. *H. cinctella*, Drap. European.

Trichia, Hartmann, 1840. (Petasina, Mörch, 1852.) Shell depressed, closely whorled, usually pilose; columellar margin callous. *H. villosa*, Drap. Mostly European.

CAMÆNA, Albers, 1850. Umbilicated, sinistral, turbinated

or globosely depressed; whorls 4-7, the last anteriorly deflected, somewhat angular usually, convex at base, compressed around the umbilicus; aperture elliptical-rounded; peristome more or less thickened, reflected, its extremities approaching. *H. cicatricosa*, Müll. (xcvi, 95). 7 sp. China, Japan.

ACUSTA, Albers, 1860. Shell umbilicate, thin, globose, closely striated, shining; last whorl large, rounded; spire subconical, aperture scarcely oblique, lunately rounded; peristome simple, acute; columellar margin dilated, reflected. 11 sp. China, Japan. *H. ravida*, Benson.

SATSUMA, Adams, 1868. Shell globosely conoidal, perforate; lip reflected, the lower portion and base of shell plane. *H. Largillierti*, Phil. 6 sp. Japan.

TRACHIA, Albers, 1860. Shell umbilicate, depressed, thin, roughened by minute granules; spire scarcely elevated; whorls four, somewhat flattened, the last deflected at the aperture and constricted in front; aperture obliquely subcircular; peristome thin, expanded, margins approximating, joined by a thin callus. *H. asperella*, Pfr. 22 sp. India, East Indies.

ANGASELLA, Adams, 1863. *H. cyrtopleura*, Pfeiffer. 3 sp. Australia.

EURYSTOMA, Albers, 1850. Shell narrowly umbilicated, globosely depressed, calcareous; whorls five, the last convex at base, deflected near the aperture; aperture oval, contracted by the last whorl; peristome lipped, wide, its extremities approaching and joined by a callus; columellar lip straight within, dilated, nearly touching the umbilicus. *H. vittata*, Müll. (xcv, 58). Ceylon.

PHASIS, Albers, 1850. Shell umbilicated, thin, depressed, convex at the base, spire a little elevated; whorls four, rapidly increasing; aperture vertical, oval; peristome simple, sharp; columellar lip dilated, reflected. *H. Menkeana*, Pfr. Cape of Good Hope.

COCHLEA, H. and A. Adams, 1855. Shell more or less globular, solid, colored; usually banded; peristome thickened or reflected; aperture rarely dentate. *H. aspersa*, Müll.

Odontura, Crosse and Fischer. Shell narrowly umbilicate, depressed globular, granulate or hairy; peristome reflected. Jaw with numerous longitudinal ribs and close transverse striæ; hinder part of foot with a median serrated keel. *H. Ghiesbreghtii*, Nyst. (xcv, 52). Mexico.

Lysinoë, H. and A. Adams, 1855. (Aglaja, Albers, 1860.) Shell umbilicate, orbicularly convex, banded; whorls $4\frac{1}{2}$ -6, the last deeply deflected in front; aperture broad-lunate, oblique; peristome thickened, expansively reflected, white, the margins approaching; that of the columella partially covering the umbilicus. *H. fidelis*, Gray (xcv, 53). 36 sp. Oregon to Peru.

Epiphragmophora, Strobel. Shell umbilicate, fusco-calcareous, peristome expanded, nearly circular; a solid calcareous epiphragm. Jaw four-ribbed, crenate. 2 sp. Argentine Republic. *H. Cuyana*, Strobel.

Eurycampta, Albers, 1860. Shell perforate, orbicularly convex; obliquely rugose-striate; brownish red, often banded; whorls $4\frac{1}{2}$ –5, the last descending; aperture ovate; peristome white, expanded-reflected, margins approaching. *H. Bonplandi*, Lam. 7 sp. Cuba, Argentine Republic.

Leptarionta, Crosse and Fischer. Intermediate between *Arionta* and *Fruticicola*; shell colored as in the former, but thin and translucent as in the latter. *H. bicincta*. Pfr. Mexico.

Micrarionta, Ancy. Shell smaller, subangulate at the periphery; lip thicker, its extremities approaching, and callously connected, impinging on the umbilicus. *H. facta*, Newcomb. Sta. Barbara Isl., Cal.

Arionta, Leach, 1820. Shell perforated, turbinately globose, thin; whorls six, convex; peristome lipped; columellar lip dilated near the umbilicus. *H. arbustorum*, Linn. (xcv, 56). Europe. *H. Californiensis*, Lea (xcv, 57). California. Different as are the habitats of these two groups of species, the shells are sufficiently related to justify placing them together in a subgenus. Curiously, they are geographically separated by the whole United States east of the Rocky Mountains, which does not contain a single species referable here.

Campylæa, Beck, 1837. (*Helicigona*, Risso, 1826. *Corneola*, Moquin-Tandon, 1855. *Cingulifera*, Held, 1837.) Shell umbilicated, planospiral, orbicularly depressed, more or less solid, glabrous or hirsute; $4\frac{1}{2}$ –6 whorls, the last deflected near the aperture; aperture oval or subcircular; peristome lipped, more or less thickened, its extremities approaching and joined by a callus; columellar lip dilated, reflected at the base, very rarely touching the umbilicus. 100 sp. Mostly Mediterranean region.

Xerocampylæa, Kobelt, 1871. *H. Carascalensis*, Fer.

Fruticocampylæa, Kobelt, 1871. *H. Ravergiensis*, Fer.

Eucampylæa, Pfeiffer, 1878. (*Cingulifera*, Held, 1837. *Corneola*, Held, 1837. *Chilostoma*, Moquin-Tandon, 1855.) Typical group. *H. Pouzolzi*, Payr. (xcv, 54).

Tacheocampylæa, Pfeiffer, 1877. *H. Raspailii*, Payr.

Elonga, Adams, 1855. (*Sterna*, Albers, 1850.) Shell plan-orboid, flattened above, spire involute, apex immersed; peristome labiate within. *H. Quimperiana*, Fer.

Chilotrema, Leach, 1820. (*Latomus*, Fitz., 1833. *Lenticula*, Held, 1837. *Vortex*, Moquin-Tandon, 1855.) Shell umbilicated. lenticular, strongly carinated; five whorls, the last deflected near the aperture; aperture basal, horizontal, oval; the reflected lip continuous, angular. *C. lapicida*, Linn. (xcv, 55). Europe.

Eremina, Pfr., 1855. (*Erinna*, Mörch, 1865. *Eremophila*, Kobelt, 1871.) Shell depressed globose, sharply striate, cretaceous, base convex. *H. desertorum*, Försk. (xcv, 59). 5 sp. Egypt.

Tachea, Leach, 1820. (*Archelix*, Albers, 1850. *Cepæa*, Held, 1837.) Shell imperforate, or umbilicus covered, turbinately globose or depressed; last whorl ventricose, deflected at the aperture, other whorls somewhat flattened; aperture obliquely rounded; peristome reflected; columellar lip narrow, callous, gibbous. 11 sp. Europe. *H. hortensis*, Müll. (xcv, 61), the common garden-snail of Europe, is a representative of this group, which includes several species. Introduced into the United States, it has become acclimated at several localities.

Rhagada, Albers, 1860. Shell imperforate, subglobose, striate, white, fasciate; whorls regularly increasing, slightly convex, the last slightly deflected in front, base convex; aperture obliquely lunar; peristome a little expanded, labiate within. *H. Reinga*, Gray (xcv, 60). 6 sp. Australia, New Zealand.

Pomatia, Beck, 1837. (*Cænatoria*, Held, 1837.) Shell globose, striate, corneo-calcareous, umbilicus partly covered or imperforate, usually fasciate; whorls 4-6, convex, the last large, ventricose, descending in front; aperture lunately orbicular, peristome patulous or straight, callous within, columellar margin reflected, usually callous. *H. pomatia*, Linn. (xcvi, 76). 45 sp. Mostly Europe, Western Asia and Northern Africa. Throughout Southern Europe the breeding of the edible snail (*Helix pomatia*) is very extensively carried on; it has been stated that Marseilles ships annually to Paris and London from 500 to 750 tons of this mollusk, and Genoa exports an equal quantity. Foreign residents in the United States are believed to be large consumers of this delicacy. In the markets of the warmer regions of Europe basketfuls of live snails are among the most familiar articles of food exposed for sale.

Cantareus, Risso, 1826. (*Lucena*, Hartmann, 1821. *Tapada*, Gray, 1840.) Paucispiral, thin, diaphanous, imperforate, peristome simple, sharp. *H. aspersa*, Born.

Cryptomphalus, Moquin-Tandon, 1855. Rather thin, imperforate; with thin, twisted columella; epiphragm plane, membranaceous. *H. aspersa*, Müller (i, 17, scalariform). 13 sp. Europe, Australia, Mexico.

Macularia, Albers, 1850. (*Otala*, Moquin-Tandon, 1855.) Imperforate, turbinately or globosely depressed; whorls four or five, convex, the last deflected near the aperture; aperture obliquely rounded; peristome sharp, lipped; columellar lip dilated, appressed, covering the umbilicus. *H. Niciensis*, Fer. (xcv, 62). 44 sp. Mediterranean region.

Iberus, Montfort, 1810. Shell narrowly umbilicated, depressed

orbicular, more or less rugose, white, obsoletely banded; whorls 4-5, the last descending in front; aperture obliquely oblong; peristome simple, expanded, labiate within; columellar margin reflected. *H. Gualtieriana*, Linn. (xcv, 63). 50 sp. Mediterranean region.

Murella, Pfr., 1877. Shell not carinated at the periphery. *H. muralis*, Müll.

Levantina, Kobelt, 1871. *H. guttata*, Oliv. 11 sp. Western Asia.

Iberus (typical). Shell carinate at the periphery. *H. Gualtieriana*, Linn.

Hemicycla, Swainson, 1840. (Mycena, Albers, 1850.) Shell imperforate, globosely depressed, rugose; four or five whorls, the last gibbous, deflected in front; aperture obliquely oval; peristome thickened, its superior and inferior lips subparallel or approaching and usually connected by a columellar callus, the inferior one lamellate within. 37 sp. Canary and Cape Verd Is. *H. Saulcyi*, d'Orb (xcv, 66).

Plebecula Lowe, 1854. (Helicomela, Lowe, 1854.) Shell umbilicated or narrowly perforate, subglobose, striated, hispidly granulate; whorls 5-5½, convex, the last but little deflected anteriorly; aperture rounded; peristome simple, diffusely callous within; margins approaching, that of the columella dilately reflexed. *H. punctulata*, Sowb. (xcv, 67). 5 sp. Madeira.

Leptaxis, Lowe, 1852. (Katostoma and Cryptaxis, Lowe, 1864.) Shell thin, globose or depressly globose, striated or rugose; whorls 5-5½, the last descending, with convex base; columella straight, entering, more or less dilated below, aperture large, rounded-lunar, or subrhombic; peristome simple, lipped within, margins approaching. *H. undata*, Lowe (xcv, 68). 30 sp. Madeira,

Leptaxis (restricted). Not carinate, imperforate.

Pseudocampylæa, Pfeiffer, 1877. Shell perforate, subcarinate. *H. Lowei*, Fer.

Lampadia, Albers, 1854. (Mitra, Albers, 1850.) Periphery carinate, depressed. *H. Webbiana*, Lowe (xcv, 69). Madeira.

DORCASIA, Gray. (Galaxias, Beck, 1837.) Shell umbilicate, subglobose; whorls convex, the last ventricose, descending at the aperture; aperture generally shining within; peristome thick, expanded, reflexed, rarely simple, obtuse, margins approximating, often joined by a callus, the columella dilated, reflexed, somewhat covering the umbilicus. *H. argillacea*, Fer. (xcvi, 94). 37 sp. So. Africa, East Indies, Australia.

HADRA, Albers, 1860. (Papuina, Albers, 1860.) 119 sp. E. Indies, China, Japan, Australia. *H. bipartita*, Fer.

XANTHOMELON, Albers, 1850. Shell striulate, globose, with a yellowish epidermis; spire small, obtusely conoidal; whorls 4-5,

the last large, inflated, descending; aperture semioval; lip thickened, shortly reflected, white, margins joined by a thin callus; columellar lip strict, callous, subtuberculate. *H. pomum*, Pfr. (xcvi, 96). 9 sp. Australia.

Anoglypta, Martens, 1860. *H. Launcestonensis*, Reeve. Tasmania.

THERSITES, Pfeiffer, 1855. Imperforate, trochiform, solid; spire conical, apex obtuse; whorls five-and-a-half, flat, the last carinated, with flattened base; aperture obliquely subrhombic, sinuously rostrate in front; peristome somewhat thickened, shortly expanded, the margins callously joined. *H. Richmondiana*, Pfr. Australia.

MEROPE, Albers, 1850. Shell imperforate, depressly globose, slightly striate, fasciate, spire very obtuse; whorls four-and-a-half, convex, the last subangulate at the periphery, umbilical region impressed, slightly deflected at the aperture, constricted, gibbous; aperture irregular, sinuately triangular; peristome filiformly callous, slightly expanded, columellar margin straight, tuberculate in the middle. *H. fringilla*, Pfr. 3 sp. Australasia.

CHLORITIS, Beck, 1837. (Erigone, Albers, 1850. Semicornu, Klein, Ads., 1855.) Shell rather solid, somewhat planorbiform, globosely depressed, profoundly umbilicated, concave above and below; spire enveloping; last whorl large, subcylindrical, anteriorly much deflected; aperture obliquely semioval; peristome a little thickened, shortly reflected, its extremities approaching. *H. unguilina*, Linn. (xcvi, 91). 32 sp. East Indies.

PEDINOGYRA, Albers, 1860. Shell widely umbilicated, depressed, solid, spire flattened, obtuse; whorls 5-6, the last large, deflected anteriorly, dilately protracted; aperture nearly horizontal, elongate-lunate; peristome expanded, margins approaching, the basal margin reflected. *H. Cunninghami*, Gray. 3 sp. Australia, New Guinea.

AMPELITA, Beck, 1837. Shell widely umbilicated, rather thin, depressed; whorls four or five, the last oblique above, deflected at the aperture; aperture oblique, oval; peristome reflected. *H. sepulchralis*, Fer. (xcvi, 92). 30 sp. Madagascar, Southern Africa.

OBBA, Beck, 1837. Shell umbilicate, ovate-globose or orbicularly depressed, frequently angulate, apex very obtuse; whorls $4\frac{1}{2}$ -6, the last deflected in front; aperture oblique or horizontal, oblong-ovate or elliptical; peristome thickened or reflected, joined by a callous margin; basal margin dilated, usually tuberculate within, impinging on the umbilicus. *H. mamilla*, Fer. (xcvi, 89). 40 sp. East Indies, Philippines.

Janira, Albers, 1850. Shell umbilicated, conoidal, subglobose, with obtuse apex; last whorl descending in front; aperture obliquely subrotund; peristome thickened, reflected,

the lips united by a shining callus; columellar lip with a tooth. *H. Ceres*, Pfr.

Phania, Albers, 1860. Shell umbilicated or imperforate, lenticularly depressed, acutely carinate; whorls $4\frac{1}{2}$ –5, the last shortly descending anteriorly, base convex; aperture irregularly triangular or rhomboidal; peristome thickened, expanded; columellar margin tuberculately dilated, the base reflected, appressed. *H. pyrostoma*, Fer. (xcvi, 88). 7 sp. East Indies.

Planispira, Beck, 1837. (*Pusiodon* [part], Swainson, 1840.) Shell with open (rarely covered) umbilicus, orbicularly depressed; spire plane or immersed in the middle; whorls 4–5, the last large, declining in front; aperture obliquely oblong-ovate; peristome acute, widely expanded, reflected, margins approximating, the basal margin sometimes tuberculate. *H. coluber*, Beck (xcvi, 90). 26 sp. East Indies.

Philina, Albers, 1850. (*Pusiodon*, Swains., 1840. *Obbina*, Semper, 1873.) Shell umbilicate, orbicularly depressed, apex very obtuse; last whorl deflected in front; aperture oblique or horizontal; peristome thickened, reflected, the margins joined by a callus, which impinges on the umbilicus. *H. planulata*, Lam.

GEOTROCHUS, Beck, 1837. Shell imperforate or perforation covered, trochiform, with elevated spire and flattened whorls; last whorl carinated or angular, base subplane; aperture angular, very oblique; superior lip slightly reflected or expanded, inferior lip thicker and reflected. *H. Ferussaci*, Lesson (xcv, 73). 131 sp. Solomon and Louisiade Is., New Guinea, Australia.

Pseudopartula, Pfr., 1855. *H. galericulum*, Mouss. Java.

ACAVUS, Montfort, 1816. (*Otala*, Schum., 1817.) Shell imperforate, globose-turbinata, oblique; whorls 3–4, rapidly increasing, the last ventricose; aperture oblong, oblique; columella oblique, wide, covered by an excavated callus; peristome thick, widely reflected, the extremities united by a shining callus. *H. hæmastoma*, Linn. (xcv, 75). 8 sp. Ceylon.

ALBERSIA, H. Adams, 1865. *H. granulata*, Quoy. 3 sp. New Guinea.

HELICOPHANTA, Beck, 1837. (*Liostoma*, Swains., 1840. *Eurycratera*, Ads., 1855.) Shell with open or covered umbilicus; thin, ovately oblong, spire short, scarcely elevated; whorls $3\frac{1}{2}$ –4, very rapidly increasing, the last inflated; aperture large, obliquely oblong-ovate; lip subexpanded, slightly thickened, margins joined by a usually thin callus, columellar margin dilated, reflected. *H. magnifica*, Fer. (xcvi, 82). 9 sp. Madagascar.

PANDA, Albers, 1860. (*Eurycratera*, Ads., 1855, part.) Shell globosely ovate, thin, striate, granulately decussated by spiral lines; spire obtuse, whorls 3–4, rapidly increasing, the last large, swollen; aperture scarcely oblique, rounded-ovate; peristome

simple, the margins joined by a thin callus, the columellar margin dilated, reflected. *H. Falconari*, Reeve. 5 sp. Australia, Madagascar, India.

STYLODONTA, Crist. et Jan., 1837. (Columplica, Mousson, 1844.) Shell imperforated, conoidal above, globose below; whorls six or seven, the last ventricose; aperture somewhat narrow, oblique; columella short, nearly direct, dentate and truncate; peristome thin, reflected at the base, extremities united by a very thin parietal callus. *H. cepoides*, Lea (xcvi, 83). 4 sp. Seychelles and Philippines.

EREPTA, Albers, 1850. Shell imperforate, rather depressed, solid, the last whorl subangulated; columella short, oblique, truncate, with a strong tooth; peristome simple, the basal margin somewhat thickened. *H. Stylodon*, Pfr. (xcv, 71). 13 sp. Mauritius.

COCHLOSTYLUS, Fer., 1819. (Bulina, Lesson, 1831. *Helicostyla*, Mörch, 1865. *Cochlostyla*, Issel, 1874.) Shell not umbilicated, oval, conical, subbulimiform, ventricose; apex somewhat obtuse; aperture large, ovate; columella straight, sometimes slightly arcuated; peristome wide, reflected. 214 sp. Philippines, etc.

Axina, Albers, 1850. Shell imperforated, usually covered by a transparent, caducous epidermis, depressed or subtrochiform; whorls four or five, flattened, the last carinate on the periphery; aperture securiform; columella short, callous, oblique; peristome labiate, reflected at the base. *H. siquijorensis*, Brod. (xcvi, 97). 10 sp. Philippines.

Pfeifferia, Gray, 1853. (Named after Dr. Louis Pfeiffer, author of *Monographia Heliceorum Viventium*, etc.) Shell globular, imperforate, thin, fragile, white, pellucid; spire not prominent, the last two whorls very large, forming nearly the entire shell; aperture rounded; lip thin, sharp. Animal too large for complete retraction within the shell; mantle-margins reflected upon a part of the surface of the shell and forming a border on the peristome; foot moderate, depressed and attenuated posteriorly, and without muciparous gland. *H. micans* (xcii, 75, 76) occurs on the leaves of bushes in the Island of Luzon. 2 sp. Philippines.

Chloræa, Albers, 1850. (Thersites, Mörch, 1865.) Shell shining, imperforate, flattened, globosely depressed or lenticular; whorls four or five, the last angular or carinated; aperture oblique, nearly horizontal, elliptical; peristome sharp, the extremities approaching, the basal lip widened, reflected. *H. fibula*, Brod. 10 sp. Philippines.

Corasia, Albers, 1850. Shell imperforate, depressed, rarely orbicularly conic, thin, diaphanous, flattened above, rounded below; whorls 4-6, the last very often angulated or carinated; aperture oblique, angular, large; columella intrant, thin,

oblique, forming an angle with the basal lip; peristome simple, thin, slightly labiate, rarely sharp. *H. virgo*, Brod. (xcvi, 98). 36 sp. Philippines. Solomon's Isles.

Calocochlea, Hartmann, 1840. (*Callicochlias* [Hartmann], Agassiz, 1847.) Shell generally covered with a deciduous, hydrophanous epidermis, imperforate, very rarely umbilicated, globosely depressed; whorls rather flat towards the apex, the last inflated; columella often intrant, dilated, oblique; peristome widely expanded, thickened, shortly reflexed. *H. pulcherrima*, Sowb. (xcvi, 99). 37 sp. Philippines.

Helicobulinus, Brödl, 1840. (*Chromocochlea*, Hartm., 1844.) Shell turbate-globose, the last whorl ventricose and forming a great part of the shell; apex obtuse; aperture rounded; columella straight; peristome widely reflected. *H. sarcinosa*, Fer. (xcvii, 100). 5 sp. Philippines.

Helicostyla, Fer., 1819. (Orustia, Mörch, 1852.) Shell imperforate, globosely conical, often covered with a deciduous, hydrophanous epidermis; spire elevated, apex very obtuse, whorls 4-8; columella solid, arcuately ascending from the broad callous base; aperture ovately lunar, nearly longitudinal, margins equal; peristome expanded, or rarely shortly reflected. *H. annulata*, Sowb. (xcvii, 3). 34 sp. Philippines.

Cochlodryas, Martens, 1860. Shell imperforate, turbate or oblong-ovate, smooth, highly colored; spire short, obtuse; whorls $4\frac{1}{2}$ - $5\frac{1}{2}$, convex; columella dilated, nearly direct; aperture lunar-ovate; peristome simple or somewhat thickened, expanded or shortly reflected. *H. polychroa*, Sowb. 14 sp. Philippines.

Eudoxus, Albers, 1850. Shell imperforate, oval-oblong, or elongated-conical; whorls six or seven, flattened, the last usually somewhat angulated; columella straight, elongated, twisted or dentate; peristome simple, rarely thick. *H. effusa*, Pfr. 9 sp. Philippines.

Orthostylus, Beck, 1837. (*Pythohelix*, Swains., 1840. *Hypselostyla*, Martens, 1867.) Shell imperforate, ovate-conical or oblong-pyramidal, fuscous under a hydrophanous epidermis; spire conoidal, apex obtuse; whorls 5-7, slightly convex; columella subvertical, rarely slightly arcuate; aperture ovately rounded; peristome somewhat thickened, shortly expanded or reflected, interior usually colored. *H. fulgetrum*, Brod. (xcvii, 1). 43 sp. Philippines.

Phengus, Albers, 1850. Shell thin, hyaline, imperforated, pyramidal; whorls six, the last somewhat angulated; aperture subovate; columella arcuated; peristome sublabiated; columellar lip dilated, excavated. *H. evanescens*, Brod. (xcvii, 2). 12 sp. Philippines, India.

Phænicobius, Mörch, 1852. Shell rimate, ovate, obliquely striate or costulate, chestnut-brown, indistinctly fasciate; whorls

6-7, tumid, slowly increasing, the last rather small; aperture semioval, oblique; columella short, callous or distinctly dentate; peristome expanded, the margins subapproximating and joined by a very thin callus, base frequently unidentate. *H. arata*, Sowb. (xcvii, 4). 7 sp. Philippines, Formosa.

Chrysallis, Albers, 1850. Shell perforate, conically ovate; whorls 5-7, hardly convex; spire cylindrically conical, apex obtuse; columella strict, wide, subreceding; aperture oblong-ovate; peristome simple, widely expanded; columellar margin dilated and reflected. *H. chrysalidiformis*, Sowb. (xcvii, 5). 4 sp. Philippines.

Canistrum, Klein, Mörch, 1852. Shell subperforated or imperforate, sometimes sinistral, oval-oblong or subfusiform; whorls 6-7; columella straight, dilated, rarely arcuated; aperture oblong, angular above; peristome thick, more or less widely reflected, very rarely thin. *H. Luzonica*, Sowb. (xcvii, 23). 18 sp. Philippines.

Prochilus, Albers, 1860. Shell subperforate, ovately pyramidal or subfusiform; whorls $5\frac{1}{2}$ -7, rather flattened; spire pyramidal; columella slightly arcuate; aperture narrow, oblong-ovate; peristome somewhat thickened, widely expanded, and slightly reflected. *H. virgata*, Jay. 8 sp. Philippines.

BULIMUS, Scopoli, 1787.

Etym.—? *Boulimos*, extreme hunger (in allusion to its voracity!); typographical error for *Bulinus*, Adanson.

Syn.—*Bulinus*, Brod.

Distr.—323 sp. Mostly South American.

Shell oval-oblong or turriculated, solid, subperforate or imperforate; whorls few, the last ventricose and large, aperture longitudinal; columella widened, rarely plicate; peristome thickened, reflected; the lips usually joined by a callus. Animal similar to *Helix*; jaw simple, with parallel ribs (xiii, 60).

Borus, Albers, 1850. Shell solid, subimperforate, oval or oval-oblong; whorls five or six, covered by a yellowish epidermis, the last ventricose; aperture oval-oblong; columella nearly straight; peristome thickened, reflected; lips united by a callus; columellar lip dilated, reflected. 33 sp. South America. *B. oblongus*, Müll. (xcvii, 16). *B. ovatus*, Müll., which attains a length of six inches, is sold in the markets of Rio Janeiro; it oviposits amongst dead leaves; the eggs have a white calcareous shell, are as large as those of the pigeon, and are eagerly sought for food by the negroes (xvii, 100). *Borus* contains the largest species of any group of *Bulimus*.

ORPHNUS, Albers, 1850. Shell imperforate, elongated-oval, solid; whorls seven or eight, with bordered sutures; aperture oblong-oval; columella usually plicate, callous; peristome thick-

ened; lips united by a thin callus; columellar lip subdilated. *B. Taunaysii*, Fer. 20 sp. South America.

DRYPTUS, Albers, 1850. Shell rimate, ovate or ovate-oblong; epidermis marbled, fuscous; whorls 5-6, oblique, the last large, ventricose, upper ones costulate; aperture oblong-ovate, columella twisted or plicate; peristome scarcely thickened, expanded, reflected, the margins joined by a callus. *B. fulminans*, Nyst. (xcviii, 24). 20 sp. Northern South America.

PACHYOTUS, Beck, 1837. (Chilonopsis, Fischer de Waldheim, 1848.) Shell perforate, oval, apex acute; whorls four or five, the last ample, the upper ones usually plicate at the suture; aperture auriculiform; columella tortuous; peristome very wide, thick, reflected. *B. Swainsoni*, Pfr. (xcvii, 12). 8 sp. South America.

STROPHOCHEILUS, Spix, 1827. (Coniclus, Albers, 1850.) Shell subperforated, oval-oblong; aperture oval or subauriculiform; columella tortuous, plicate above; peristome widely reflected; the lips united by a thin callus; columellar lip dilated, reflected. *B. Milleri*, Sowb. (xcvii, 15). 8 sp. Brazil.

CARYODES, Albers, 1850. Shell solid, imperforate, oblong-oval; whorls five, plicate at the suture; aperture oval, angular above, half the total length; peristome simple, obtuse; lips united by a callus; columellar lip thickened, reflected. *B. Dufresnii*, Leach (xcix, 60). 4 sp. Australia, Tasmania.

LEUCOTÆNIUS, Albers, 1860. Shell perforated, ovate-acute, thick; spire conical with rather obtuse apex; whorls seven, planulate; columella straight, thickened, slightly receding; aperture acutely ovate; peristome simple, margins joined by a heavy callus, columellar margin thickened, dilated and reflected. *B. Favannii*, Lam. 3 sp. Seychelles, Madagascar.

LIPARUS, Albers, 1850. Shell slightly perforated, oval, conic; spire a little obtuse; whorls 6-8, the last three-fourths the total length; aperture oval; peristome simple, sharp; columellar lip narrow, dilated above and reflected. *B. atomatus*, Gray. 20 sp. Australia.

PACHNODUS, Albers, 1860. Shell perforate, very rarely imperforate, ovate, conical, thin, striate or decussate; apex rather acute; whorls 5-6½, the last ventricose, nearly the length of the spire; aperture ovate or ovate-oblong; peristome simple, thin, the columellar margin dilated, reflected, free. *B. tumefactus*, Reeve (xcix, 61). 17 sp. Africa, Madagascar, Seychelles.

OVELLA, Pfeiffer, 1878. *B. Socotrensis*, Pfr. Socotora.

RHACHIS, Albers, 1850. (Achatinelloides, Nevill.) Shell perforated, oval or conical; whorls 5-8, the last sometimes angulated; aperture oval; peristome simple, sharp; columellar lip dilated, reflected, sometimes folded. *B. punctatus*, Anton (xcix, 62). 40 sp. E. and W. Africa, Mauritius, India, East Indies.

CERASTUS, Albers, 1860. Shell rimate, ovate, costulate or striulate, thin, corneous; whorls 6-7, somewhat convex, the last as long as the spire; aperture rounded-ovate; peristome reflected, with approaching margins joined by a thin callus. *B. distans*, Pfr. 13 sp. India, E. Africa.

HAPALUS, Albers, 1850. (*Harpalus*, Austin, 1872.) Shell imperforate, elongated, very thin, transparent; whorls six or seven, the last more than half the total length; columella callous, twisted above; aperture oval, angular above; peristome simple, sharp; outer lip arcuated above. *B. Grateloupi*, Pfr. 17 sp. India, East Indies, Philippines, Guinea, etc.

RAPHIELLUS, Pfeiffer, 1855. *B. achatinellinus*, Forbes. Galapagos.

BULIMULUS, Leach, 1814.

Syn.—*Peristoma*, Kryn., 1833. *Zebrina*, Held, 1837.

Distr.—545 sp. Tropical America.

Shell oblong, aperture longitudinal, edentulate, peristome thin, margins unequal; columella integral. Jaw arcuate, closely plicate. Lingual membrane (of *B. dealbatus*) broad, central teeth tricuspid, the median cusp very long; laterals bicuspid; the dentition varies in the different groups.

The following sections form the subgenus:—

GONIOGNATHMUS, Crosse and Fischer, 1875. It is characterized by a jaw having plications that are angulated in the centre, and by lingual teeth with narrow inner cuspidation, nearly as long as the median cusp, which is obtuse and broad.

Eudiotus, Albers, 1860. Shell imperforate, ovate or ovate-oblong, smooth, shining, pellucid, thin; whorls 5-6, the last exceeding the spire; aperture ovate or ovate-oblong; columella strict, thin; peristome acute, simple. *C. pseudosuccinea*, Moric. 6 sp. South America.

Plectostylus, Beck, 1837. Shell imperforate, thin, translucent, conic-oval; spire acute; columella intrant, slim; peristome thin, sharp. *B. Chilensis*, Lesson (xcviii, 27). 18 sp. South America.

Drymæus, Albers, 1850. (*Hamadryas*, Albers, 1850.) Shell perforated or umbilicated, oblong, lightly striate or rugose; spire elongated, sharp; whorls seven or eight; aperture oblong-oval; columella subtoruous; peristome simple; columellar lip reflected. *B. xanthostomus*, d'Orb. (xcviii, 28). 100 sp. Mexico, Central and South America, West Indies.

Leiostracus, Albers, 1850. Shell thin, perforated, oblong-conic, shining; spire elevated, apex acute; whorls seven or eight; aperture oval or oblong-oval; peristome thin, more or less expanded; columellar lip dilated, reflected. *B. Mexicanus*, Lam. (xcvii, 20). 38 sp. Florida, West Indies, Mexico, So. America.

Anctus, Albers, 1860. Shell rimate, ovate-conical, thin, striate, white, strigate with brown; whorls seven, rather flat, the last compressed in front; aperture narrowly oblong, vertical, peristome shortly reflected, the margins parallel. *B. anchistoma*, Wagner (xcviii, 29). Brazil.

Mesembrinus, Albers, 1850. Shell subimperfurate, or perforation covered, oval-conic, longitudinally striate or a little rugose; whorls six or seven; aperture oval-oblong; columella subtortuous; peristome simple, sharp; columellar lip more or less dilated, reflected. *B. virgulatus*, Fer. (xcviii, 30). 81 sp. Lower California, Mexico, Florida, W. Indies, Central and So. America.

Mormus, Albers, 1860. Shell rimate, oblong-conical, striate or costulate, thin, white, usually fuscously variegated; whorls six or seven, the upper ones somewhat flattened, the last rather tumid; aperture about half the length of the shell, subovate; peristome simple, the columellar margin dilated and reflected. *B. papyraceus*, Mawe (xcviii, 32). 43 sp. L. California, Mexico, Central and South America.

Scutarus, Albers, 1850. Shell perforated or umbilicated, oval-conic, striated, granulated, somewhat hirsute; whorls 4-7, the last ventricose, somewhat narrowed at the base; aperture oblong-oval; peristome expanded, usually reflected, a little thickened within. *B. thamnoicus*, d'Orb. (xcviii, 33). 28 sp. L. California to So. America.

Pyrgus, Albers, 1850. Shell turreted; whorls nine, the last being a third of the total length; aperture oval; peristome simple, thin; columellar lip reflected above. *B. turritus*, Brod. Peru.

Ataxus, Albers, 1850. Shell umbilicated, oval-conic; whorls six, the last compressed and angular around the umbilicus, which is very large; aperture narrow, oblong, subangular at the base, about one-third the length of the shell; peristome simple; lips closely approaching at their extremities; columellar lip straight, expanded above. *B. umbilicaris*, Soul. (xcvii, 21). 5 sp. So. America.

Eurytus, Albers, 1850. Shell imperfurate, thin, oval-oblong; whorls four or five; aperture rather longer than the spire, oblong-oval; columella arcuated; peristome subreflected; lips united by a thin callus. *B. Cathcartiæ*, Reeve (xcviii, 25). 33 sp. South America.

Oxycheilus, Albers, 1850. Shell thin, pellucid, shining, subimperfurate, subfusiform, apex acute; whorls six or seven; aperture oblong-oval, shorter than the spire; columella nearly straight, slim; peristome simple; columellar lip reflected. *B. Hanleyi*, Pfr. (xcvii, 17). Brazil.

Peronæus, Albers, 1850. Shell perforated or fissured, oblong-turreted or subulate; whorls 8-11, convex; aperture oblong or

oval, a third of the length of the shell; columella intrant or a little arcuated; peristome simple, expanded; columellar lip dilated. *B. montivagus*, d'Orb. (xcviii, 36). 26 sp. South America.

Otostomus, Beck, 1837. Shell perforated, pyramidal, thin; whorls four or five, the last angulated with a flattened base; aperture elongated, oblique, subtriangular; peristome reflected, the lips joined by a callus. *B. auris-leporis*, Brug. (xcvii, 13). 9 sp. South American.

Navicula, Spix, 1827. *B. navicula*, Wagner (xcvii, 14). Brazil.

Semiclausaria, Pfeiffer, 1855. *B. semiclausus*, Pfr. N. Grenada.

Plekocheilus, Guilding, 1828. (*Auricula*, Swains., 1840. *Caprella*, Guild., 1825.) Shell scarcely umbilicated, oval, fusiform; aperture elongated-oval, angulated above; columella with a large fold; peristome thick and wide. *B. auris-Sileni*, Born (xcvii, 18). 28 sp. South America, West Indies.

Goniostomus, Beck, 1837. Shell narrowly perforate, fusiform or oblong-conic, the last whorl attenuated to the base; aperture oblong, angulated at its extremities; columella arcuated, sub-plicate; peristome reflected. *B. goniostomus*, Fer. (xcvii, 10). Brazil.

Anthinus, Albers, 1850. Shell narrowly perforated, oblong-conic; spire turriculated; whorls six or seven, the last as long as the spire; aperture oval-oblong, violet-tinted within; columella dentate or plicate; peristome wide; columellar lip expanded. *B. Myersii*, Sowb. (xcvii, 11). 5 sp. South America.

The following groups form the subgenus:—

ORTHOTOMIUM, Crosse and Fischer, 1875. It is American, and is characterized by vertical folds on the jaw, which are narrower in the centre; inner cusp of the teeth very short.

Leptobyrsus, Crosse and Fischer, 1875. *B. spirifer*, Gabb. Lower California.

Thaumastus, Albers, 1860. Shell imperforate or rimate, conically oblong, striulate, white strigated with fuscous; aperture oblong-oval, usually not half the length of the shell; columella distinctly twisted; peristome obtuse, simple or shortly expanded, columellar margin reflected, more or less appressed. *B. Hartwegi*, Pfr. (xcviii, 31). 47 sp. Southern United States, Mexico, West Indies, South America.

Globulinus, Crosse and Fischer, 1875. *B. sufflatus*, Gould. 2 sp. Lower California.

Rhinus, Albers, 1860. Shell perforated, conical or oblong-conical, corneous, the epidermis mostly pubescent; whorls 6–7; aperture semioval; columella dilated, subtwisted; peristome shortly reflected, white. *B. heterotrichus*, Moric (xcviii, 26). 9 sp. Brazil, Venezuela, Ins. Trinidad.

Leptomerus, Albers, 1850. Shell thin, subperforated or very rarely imperforate, oval or oblong-conic; whorls 5-7, slightly inflated below; aperture oval or oblong, shorter than the spire; columella usually subarcuated; peristome simple, thin and sharp; columellar lip a little reflected. *B. Meridanus*, Pfr. (xcvii, 19). 52 sp. South and Central America, West Indies.

Næsiotus, Albers, 1850. (*Omphalostyla*, Schlütt., Ads., 1855.) Shell subperforate, oval-conic or oblong-turreted, longitudinally striated; whorls 6-8; aperture oblong, angular at base, one-third the length of the shell, columella vertical; peristome simple, sublunate within; lips subparallel, united by a small callus; columellar lip dilated above. *B. rugiferus*, Sowb. (xcviii, 35). 16 sp. Galapagos Isles.

Rhabdotus, Albers, 1850. Lip not expanded nor reflected. *B. dealbatus*, Say (xcviii, 34). 65 sp. Alabama, L. Cal., Mexico to South America.

Pleuropyrgus, Martens. Shell imperforate, turreted, rather solid, with obtuse ribs; whorls fifteen, convex; aperture semi-oval; peristome simple, the margin shortly expanded. *B. Chemnitzoides*, Forbes. Galapagos Isles.

BOSTRYX, Troschel, 1847. Shell turreted, scalariform, with wide umbilicus; whorls six, the first four regular, the last two shouldered, bicarinated; aperture subquadrangular; peristome simple or slightly expanded, continuous. *B. solutus*, Troschel (xcvii, 22). 5 sp. South America.

PLACOSTYLUS, Beck, 1837. Shell imperforate, oblong, conical, longitudinally striate; last whorl longer than the spire; aperture oval-oblong, irregular, angular above; columella a little arcuated, callous; columellar lip wide, peristome thick, lips united by a wide callus, shining and usually dentate or tuberculate. *B. insignis*, Petit (xcvii, 6). 58 sp. Australasian and Polynesian.

Euplacostylus, Crosse. Edge of aperture thickened. Animal with hinder part of body obtuse. *B. fibratus*, Martyn. Terrestrial. New Caledonia, Solomon's and Fiji Isles.

Charis, Albers, 1850. *B. fulguratus*, Jay. Fiji Islands.

Apastus, Albers, 1850. Shell imperforate, fusiform, thin, diaphanous, lightly striate; whorls six, rapidly enlarging, the last longer than the spire; aperture oval-oblong, rounded at the base; columella subarcuated; peristome labiate, reflected, lips united by a thin callus. *B. miltocheilus*, Reeve (xcvii, 7). Solomon Isles.

AMPHIDROMUS, Albers, 1850. (*Beddomea*, Nevill.) Shell dextral or sinistral, perforate or covered, ovate-conical or oblong-ovate; whorls 6-7½, scarcely convex; columella dilated, twisted, receding; aperture oblong, semioval; peristome thickened, expanded, reflected, outer margin arcuate. Jaw feebly ribbed; dentition like *Orthalicus*. *B. perversus*, Linn. 47 sp. Java, Siam, etc.

BULIMINUS, Ehrenb., 1831.

Distr.—350 sp. Old world.

Shell solid, rimate, oblong-conic or fusiformly cylindrical, apex horny, rather obtuse, last whorl shorter than the spire; aperture small, obliquely oval; peristome straight, labiate within, simple or with teeth, right margin rather expanded, the columellar reflexed and patulous.

Animal similar to *Bulinus*. Jaw arcuated, finely longitudinally striate; dentition like *Helix*.

Petriæus, Albers, 1850. Shell oblong-conical or subcylindrical; whorls 6–8; aperture oval or oblong-oval; columella folded; peristome thick, sometimes reflected, the extremities approaching, usually united by a callus. *B. labrosus*, Oliv. (xcix, 63). 32 sp. Greece, Asia Minor, Turkestan, Arabia, E. Africa, India.

Eua, Gray, 1840. (*Merdigerus*, Albers, 1850. *Peristoma*, Kryn., 1833. *Napæus*, Albers, 1850.) Shell oval-oblong or subcylindrical; whorls 7–9, the last about half the total length; aperture oval; peristome labiate within; columellar lip dilated. *B. badius*, Fer. (xcix, 64). 80 sp. Warm regions of the eastern hemisphere.

Leucochiloides, Pfr., 1878. *B. cænopicta*, Hutton (xcix, 65). 10 sp. India, Arabia, Senegal, etc.

Cylindrus, Fitz., 1833. *B. obtusus*, Drap. Austrian Alps.

Medea, Boettger, 1883. Ovately conical, profoundly rimate, thin, shining; white or corneous, sometimes with a median fuscous zone; whorls spirally lineolated, the last rounded at base; aperture large, with remote margins, sometimes joined by a slight callus. *B. Raddei*, Kobelt. Caucasus.

Pupoides, Pfr., 1854. *B. marginatus*, Say. 7 sp. United States, West Indies, Mazatlan.

Mastus, Beck, 1837. Shell cylindrical, subpupiform, subperforate, apex obtuse; whorls numerous; aperture small, rounded-oval; columella short, straight, peristome labiate within. *B. polygyratus*, Reeve (xcix, 66). 11 sp. India, Zanzibar, etc.

Zebrina, Held, 1837. (*Brephulus*, Beck [part], 1837. *Bulinulus*, Risso, 1826. Adams, 1855.) Shell solid, rimately perforated, oblong-conic or fusiformly cylindrical, apex horny, rather obtuse, last whorl shorter than the spire; aperture small, obliquely oval; peristome straight, labiate within, dentate, right margin rather expanded, the columellar reflexed and patulous. *B. fasciolatus*, Fer. (xcix, 67). *B. Tournefortianus*, Fer. (xcix, 68). 36 sp. Eastern Europe, W. Asia.

Chondrula, Beck, 1837. (*Chondrus*, Cuv., 1817. *Jaminia*, Risso, 1826. *Gonodon*, Held, 1837. *Eucore*, Agassiz, 1837. *Mirus*, Albers, 1850.) Shell rimate, ovate-oblong, apex acuminate; whorls 7–9, the last nearly one-third of the length;

aperture semioval, internally generally contracted; peristome labiate, furnished with numerous teeth, or very rarely simple; sometimes the apertural paries is unidentate at the external angle. *B. quinquedentatus*, Mühlf. (xcix, 69). 60 sp. Mostly Eastern Europe and W. Asia.

ODONTOSTOMUS, Beck, 1837. (Cyclodontina, Beck [part], 1837.) Shell rimately perforate, cylindrically fusiform; spire elongate, turreted; last whorl compressed at the base, often externally scrobiculate; aperture oblong, contracted, with from 3 to 6 teeth; parietal wall with an intrant lamella; peristome expanded, reflexed, the margins approximate, joined by a thin callus. *B. Pantagruelianus*, Mor. (xcvii, 8). 35 sp. Brazil, Argentine Republic.

Macrodontes, Swains., 1840. Shell bulimiform; spire longer than the aperture, which is surrounded with large teeth; lips united, the outer large, dilated, reflected. *B. odontostomus*, Sowb. 3 sp. Brazil, Buenos Ayres.

Plagiodontes, Döring. Shell ovate, aperture with many teeth and a transverse plait behind; jaw strongly ribbed. La Plata to Patagonia, So. America. *P. dentatus*, Wood. *P. dædaleus*, Desh.

TOMIGERUS, Spix, 1827.

Distr.—*T. principalis*, Sowb. = *gibberulus*, Burrows (xcvii, 9). 5 sp. Brazil, Venezuela.

Shell perforate, turbinate-globular, last whorl ventricose, aperture rounded or triangular, turned upward, vertical; peristome expanded or reflected, the lips joined by a callus; interior of aperture contracted by numerous entering lamellæ.

ANOSTOMA, FISCHER, 1807.

Syn.—Tomogerus, Montf., 1810. Angystoma, Schum., 1817.

Distr.—5 sp. Brazil. *A. globulosa*, Lam. (xciii, 1).

Shell orbicular-depressed; spire convex, more or less obtuse; last whorl abruptly turned upwards at the aperture, which thus faces dorsally, has reflected peristome, thickened and dentate within, its extremities connected by a callus, which is also dentate. Jaw smooth.

Ringicella, Gray. Peristome perforated by a small canal. *A. globulosa*, Lam.

BOYSIA, Pfeiffer, 1850.

Syn.—Hypostoma, Albers, 1850. Hypostrema, Albers, 1860.

Distr.—*B. Bensoni*, Pfr. (c, 98). Bengal.

Shell conic-globose, thin, umbilicus a shallow slit, last whorl ascending on the spire; aperture oblique, subrotund, without teeth, turned upwards; peristome thick, not reflected, the extremities joined by a callus.

STROPHOSTOMELLA, Fischer, 1883. Shell lenticular, with arcuated umbilical slit; last whorl carinated, ascending, applied to the penultimate; aperture semiorbicular, a little dilated transversely; peristome continuous, reflected; columella thickened. *B. Reussi*, Stoliczka. Cretaceous of Gosau.

ANASTOMOPSIS, Sandberger, 1870.

Distr.—*A. rotellaris*, Matheron. Cretaceous.

Shell plane above, periphery carinated, convex and profoundly umbilicated below; whorls narrow, numerous, the last one ascending so that the falciform aperture is in the plane of the spire; interior sharply lamellate.

LYCHNUS, Matheron, 1832.

Syn.—*Anadromus*, Sandberger.

Distr.—Cretaceous; France and Spain. *L. Matheroni*, Requien.

Shell discoidal, convex at base, with arcuated umbilical slit; whorls of the spire few, narrow, forming a small column, last whorl very large, ascending and partially covering the spire to the apex, then deflected downwards; aperture on the side of the base, horizontal, oval, transverse, without teeth; peristome reflected.

HYPSELÖSTOMA, Benson, 1856.

Syn.—*Tanystoma*, Benson, 1856.

Distr.—3 sp. Burmah. *H. tubiferum*, Bens. (c, 99). Ava.

Shell convolute, conoidal, umbilicus open, last whorl free, protracted, turned upwards; aperture trumpet-like and dentate; peristome horizontal, expanded.

PARTULA, Fer., 1819.

Distr.—70 sp. Central Polynesia. *P. faba*, Mart. (xcix, 70). *P. Otaheitana*, Brug. (xcix, 71).

Shell dextral or sinistral, oblong-ovate or conic-ovate; outer lip reflected; aperture auriform or ovate, more or less oblique, occasionally contracted by the wide and often dentate columella, and by a labial or pillar-tooth; surface with very minute spiral striæ, which are foveate at the apex.

Viviparous. Jaw very thin, of oblique lamellæ sharply angulated at the centre; lateral teeth tricuspidate, the inner cusp short, marginals narrow, arcuate, tricuspidate.

Dr. W. D. Hartman, who has made a special study of this genus, proposed in 1881 a number of subgenera: *Nenia*, *Astræa*, *Clytia*, *Ilia*, *Ænone*, *Helena*, *Pasithea*, *Æga*, *Echo*, *Latia*, *Evadne*, *Harmonia*, *Matata* and *Sterope*. Some of these names are pre-occupied by other authors. I give no diagnoses for the reason

that I believe these groups have but slight value; an opinion in which Dr. Hartman now coincides.

PELTELLA, Web. and Van Ben., 1836.

Syn.—Pectella, Peltellina, Gray, 1847, Gæotis, Shuttlew., 1854.

Distr.—Brazil, Porto Rico. *P. palliolum*, Fer. (ci, 43).

Animal limaciform, rounded above, flat below, sides widely expanded; tentacles simple; mantle small, oval, posterior, concealing a shell; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; distinct locomotive disk? external respiratory and anal orifices on the right anterior margin of the mantle; orifice of combined genital organs behind and below right peduncle.

Shell internal, sigaretiform, rudimentary, small, flat, oblong, subspiral, nucleus infero-posterior.

Jaw ribbed. Lingual ribbon with peculiar long, narrow teeth, centrals, laterals and marginals bluntly tricuspid.

From Ferussac's figure 4 it appears probable that the shell may be more properly described as external, but covered by an accessory process of the mantle.

The South American forms are said to be most frequently found partly buried in damp earth in the woods of Brazil; the West Indian species crawl at night and in the morning on the trunks and foliage of Bananas or Plantains.

PELLICULA, Fischer, 1855.

Distr.—3 sp. West Indies. *P. depressa*, Rang (c, 39). Guadeloupe.

Shell like Philine. Last whorl and aperture embracing nearly the whole shell, the spire being minute and inconspicuous; inferior tentacles rudimentary.

Animal not able to retire within its shell, which occupies the middle of the back. Jaw like *Amphibulima*.

BINNEYA, J. G. Cooper.

Syn.—Xanthonyx, Cr. and Fisch.

Distr.—3 sp. Mexico, and islands of the southern coast of California. *B. notabilis*, Cooper (xcii, 73).

Animal sublimaciform, blunt before, tapering behind; tentacles simple; mantle subcentral, covered by a shell, with an anterior expansion; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; a distinct locomotive disk; external respiratory and anal orifices on the right posterior margin of the mantle, under the peristome of the shell; orifice of combined genital system behind and below the right eye-peduncle. Shell external, paucispiral, auriform, not enclosing

the animal. Jaw ribbed. Lingual membrane with tricuspid central teeth, bicuspid laterals, and quadrate marginals.

The animal has the peculiarity during estivation of forming a testaceous covering extending from the peristome over the parts not protected by the shell.

The body is not attached its whole length to the foot, the viscera forming a turbinate spiral mass, partially protected by the shell.

AMPHIBULIMA, Blainv., 1825.

Distr.—8 sp. West Indies. *A. patula*, Brug. (c, 37).

Shell oval, ventricose, rugose, membranaceous, paucispiral; spire small; last whorl very large, angular; aperture very large, rounded-oval; peristome acute.

Animal capable of withdrawing into its shell. Jaw plicate, the plicæ angulated at the centre; central tooth very long, middle cusp of the lateral teeth swollen; marginals short, tricuspidate.

RHODONYX, Fischer, 1873. (Mastogyra, Ancey, 1881.) *A. rubescens*, Desh. Guadeloupe. Shell resembling Succinea.

SIMPULOPSIS, Beck, 1837. Shell semioval, very thin, membranaceous, paucispiral, the last whorl ventricose; aperture very large, oblique, rounded-oval; columella arcuated; peristome simple, sharp. *A. rufovirens*, Moric (c, 38). 20 sp. Brazil, West Indies.

Platysuccinea, Ancey, 1881. Shell approaching Succinea. *S. Portoricensis*, Shuttl.

FAMILY ORTHALICIDÆ.

Shell bulimiform, thin, ventricose. Jaw with a triangular median portion, and on either side oblique imbricating plates, free in front and adhering behind (xiii, 58). Central and lateral teeth quadrangular at base, with broad central and rudimentary lateral cusps; marginal teeth bicuspidate. Living upon trees, and secreting during the dry season a thick coriaceous epiphragm.

ORTHALICUS, Beck, 1837.

Distr.—32 sp. Tropical America. *O. Bensoni*, Reeve (xcviii, 37).

Shell imperforate, oval, conic; whorls seven or eight, the last longer than the spire; aperture rounded-oval; columella nearly straight, but little thickened; peristome simple; lips united by a thin callus.

Sultana, Shuttl., 1856. Inflated, apex pitted. *O. Dennisoni*, Reeve.

Zebra, Shuttl., 1856. Narrower, apex smooth. *O. undata*, Brug. (xcviii, 38).

Corona, Albers, 1850. Shell usually sinistral, oval-oblong; spire elongated, subturreted, summit obtuse; whorls eight, the last two-thirds the total length; aperture semioval; columella tortuous, plicate, callous above, slim at the base, truncate; peristome simple, sharp; outer lip uniting with the columella at a sharp angle. *O. regina*, Fer.

Orthalicinus, Crosse and Fischer, 1875. *O. fasciata*, Müll. (xcviii, 39). Cuba, Florida.

Calycia, Adams, 1865. *O. crystallina*, Reeve. Waigiou, Malay Archipelago.

LIGUUS, Montfort, 1810. (Chersina, Beck [pt.], 1837. Pseudotrochus, Mörch, 1852.) Shell imperforate, solid, elongately conical, apex acuminate, variously fasciate with gay colors; whorls 7-8, the last about one-third the total length; columella straight, in the adult distinctly truncate; aperture lunately oval, subangulate; peristome simple, acute, the margins joined by an entering callus. *O. virginea*, Linn. (xcviii, 40). 6 sp. West Indies.

Porphyrobaphe, Shutt., 1856. Shell imperforate, oblong, solid, usually plicately striate, apex obtuse; whorls 6-8, the last ventricose; columella thick, plicately twisted; aperture oblong-oval; peristome thickened, expanded-reflected, margins united by a thin callus. *O. iostoma*, Sowb. 12 sp. So. America.

FAMILY ACHATINIDÆ.

Shell moderately thick, with more or less elongated spire; the last whorl generally ventricose; aperture large; columella truncate at the base; peristome usually simple, sharp.

Jaw finely plicate or costulate, thin; central tooth very small, laterals tricuspid, with the central cusp much the longest, marginals short, tricuspid.

ACHATINA, Lam., 1799.

Etym.—Agate-shell.

Syn.—Cochlitoma, Fer., 1819. Onœa, Gistel, 1848.

Distr.—73 sp. Mostly African; arboreal. *A. zebra*, Chemn. (xcviii, 43).

Shell oblong-oval, with conical spire, very rarely turriculated, sometimes sinistral; whorls 6-9, the last more or less ventricose; columella tortuous, arcuated, truncate below; aperture oval, expanded below, sharply angulated behind; peristome sharp; lips united by a more or less callous shining deposit.

The Achatini are the largest of all land-shells, even exceeding the great Bulimi of the *Borus* group which replace them in the similar latitudes of South America; like them, the eggs are large, with a calcareous shell, being over an inch in length.

Homorus, Albers, 1850. Imperforate, turreted, apex obtuse,

striate or costulate; aperture oval, short, about one-third or one-fourth the length of the shell; columella arcuate, abruptly truncate; peristome simple, acute. *A. cyanostoma*, Ruppell.

PERIDERIS, Shuttleworth, 1856. (Corona, Albers [pt.], 1850.) Shell imperforate, ovately conical or oblong, apex papillary, shining, striate, decussated by very minute spiral lines, epidermis very thin; whorls 6-7, the last usually obsoletely angulated; suture wrinkled, marginate; aperture short, suboval, columella slightly twisted, obliquely subtruncate; peristome simple, acute. *A. balleata*, Gould (xcviii, 41). 18 sp. West Africa.

LIMICOLARIA, Schum., 1817. Shell perforate, conically or turreted oblong, last whorl shorter than the spire; aperture oblong, suboval; columella vertical, protracted at the base; peristome simple, thin, straight, columellar margin dilated, arcuately reflexed. *L. Æquatoria*, Rve. (xcviii, 42). 31 sp. Africa.

PSEUDACHATINA, Albers, 1850. Shell solid, oval, turriculated; whorls eight or nine, the last obtusely angular at the periphery, and exceeding half the length of the shell; columella subtortuous, a little arcuated, truncate-tuberculate below; aperture oval; peristome thick, slightly reflected; lips united by a callosity. *P. Downesii*, Gray (xcviii, 44). 7 sp. W. Africa.

COLUMNA, Perry, 1811. Shell always sinistral, much elongated, decussated, whorls oblique; constricted at suture; apex obtuse; columella callous, spirally twisted, truncate at base; peristome simple, sharp. *C. flammea*, Martyn (xcviii, 46). 4 sp. W. Africa. Fossil Achatinæ occurring in the eocene of Upper Missouri, and in the Paris basin, are referred to this group.

CHILONOPSIS, Fischer de Waldheim, 1848. Shell bulimiform, thick; aperture ear-shaped, both lips greatly thickened, the columellar lip tuberculate above, obliquely truncate below. *Bulimus auris-vulpina*, Chemn., which occurs subfossil in the island of St. Helena, is the type of this group.

STENOGYRA, Shuttleworth, 1850.

Syn.—Sira, Schmidt, 1855. Subulina, Adams, 1855.

Distr.—250 sp. World-wide, tropical and temperate regions.

Shell elongated, turriculated, whorls numerous, apex obtuse or truncate; aperture oval, small, columella thin, straight; peristome simple, sharp.

Median tooth of the radula very small; jaw thin, feebly arcuated, vertically plicate.

OBELISCUS, Beck, 1837 (= Stenogyra, restricted). Shell long, imperforate, elongate-turreted, scarcely shining; whorls 10-18, last about one-fourth the total length; columella straight, not truncate; peristome simple. *S. obeliscus*, Moric. (xcix, 31). 38 sp. West Indies, Central and South America, Natal, Philip-pines, etc.

RUMINA, Risso, 1826. (Orbitina, Risso, 1826. *Cylindrina*, Schlütt., 1838.) Shell turriculated, the adult always truncate; whorls numerous, plane, with moderately impressed suture; aperture small, oval, the peristome slightly thickened, its extremities united by a slight callus.

S. decollata, Linn. (xcix, 82, 83), is a native of the Mediterranean region of Europe; it is acclimated at Charleston, S. C.

CLAVATOR, Martens, 1860. Shell turreted-conical, not shining; flavously striate; peristome simple, obtuse. *S. clavator*, Petit. 2 sp. Madagascar.

OPEAS, Albers, 1850. Shell thin, umbilicated or imperforate, usually small, subulate, covered with striae or small ribs; aperture oval-oblong; peristome simple, columellar lip reflected. *S. octonoides*, Ads. (xcix, 84). 63 sp. West Indies, Java, etc.

SPIRAXIS, C. B. Ad., 1850. Shell elongated, acuminate, very finely longitudinally striate; columella tortuous; peristome simple. 44 sp. India, China, West Indies, Mexico, Central America.

Euspiraxis, Pfr., 1855. Turreted, thin, striulate or costulate, shining; whorls 6-9, rather flat; aperture ovate-oblong, one-third to one-half the total length; peristome simple, acute. *S. aberrans*, Pfr. (xcix, 85).

Nothus, Albers, 1850. Shell imperforate, oblong-conic, thin, diaphanous; whorls six or more, the last about the length of the spire; columella short, doubly tortuous; columellar lip reflected; aperture small, semioval; peristome simple. *S. Salleana*, Pfr.

Lamellaxis, Strebel and Pfeffer, 1882. *S. Mexicanus*, Pfeiffer.

SUBULINA, Beck, 1837. (Macrospira, Swains., 1840.) Shell diaphanous, cylindrical, turriculated or conic-elongated, with obtuse summit; whorls numerous, slowly increasing in size; aperture oval, short, columella subarcuated and obliquely truncated at base; peristome sharp. *S. sulcatus*, Gray (xcix, 86, reversed in error). 90 sp. India, E. and W. Africa, West Indies, Mexico, Central America.

Glandinella, Pfeiffer, 1878. *S. Poeyanus*, Pfr. Isle of Pines, near Cuba.

GLESSULA, Albers, 1860. (Electra, Albers, 1850.) Shell ovate-oblong, thin, diaphanous; spire pyramidal, apex obtuse; whorls numerous, the last inflated; columella short, arcuated, abruptly truncated. *G. Ceylonica*, Pfr. (xcix, 89). 59 sp. India, East Indies, W. Africa.

MELANIELLA, Pfeiffer, 1859. Shell imperforate, costate, decussated; brownish horn-color; whorls nine, slightly convex, gradate; aperture effuse at base, ovate; columella strict; peristome simple, subcontinuous. *S. acuticostata*, d'Orb. (xcix, 87). 8 sp. Cuba, Trinidad, Florida.

LEPTINARIA, Beck, 1837. Shell oval, pellucid; columellar lip doubly toothed; outer lip smooth, sharp. *L. Cumingiana*, Pfr. (c, 92). 16 sp. West Indies, Central, and Northern South America.

FERUSSACIA, Risso, 1826.

Syn.—Pegia and Vedianthus, Risso, 1826. *Strobilus*, Ads., 1855.

Distr.—62 sp. Mediterranean region, Canaries, Malaysia, etc. Fossil. Eocene.

Shell small, ovately fusiform, imperforate, polished, transparent, columella plicate, subtruncate; outer lip simple. Jaw thin, numerous plicate, margins crenulated.

Folliculus, Agassiz, 1837. (Euferussacia, Bourg., 1870.) Typical group. *F. Gronoviana*, Risso (c, 93). *F. Vescoi*, Bourg. (c, 94). 37 sp. Southern Europe, N. Africa, Madeira.

Pseudostreptostyla, Nevill. Pillar-lip resembling that of *Spiraxis*. *F. abnormis*, Nevill. So. France.

Cylichnidia, Lowe, 1854. Shell oval-fusiform, columella uniplicate; outer lip thin. *C. ovuliformis*, Lowe (c, 95). 2 sp. Madeira.

Tornatellinoides, Pfr., 1877. Resembling *Tornatellina*. *C. achatinoides*, Pfr. 8 sp. N. Africa, Syria, Gambier Isles.

Pseudazeca, Pfr., 1877. Resembling *Azeca*. *C. procerula*, Mor. 5 sp. Algiers.

Cryptazeca, Folin, 1877. Shell like *Cionella*, with one columellar tooth; hinder end of the foot truncate, with several unicellular glands; mantle not extended beyond the shell. *C. monodonta*, Folin. Bayonne.

Lowea, Watson. Mantle thinly spread over the outside of the shell, and extending like a tongue backwards behind the posterior corner of the aperture; tail abruptly truncate, with a mucous gland. *L. melampoides*, Watson. Madeira.

AZECA, Leach, 1818. (Agraulina, Bourg., 1858.) Shell small, oval-elliptical, corneous, smooth, polished; aperture half the total length, oval or oblong, with numerous teeth; columella compressed, callous, truncate-dentate at the base; peristome simple, obtuse, labiate within, the extremities usually united by a tubercled callus. 17 sp. Europe, Algiers, Canaries.

Azecastrum, Bourg., 1858. Typical group. *A. tridens*, Pult. (c, 96). 2 sp. Europe.

Alsobia, Bourg., 1858. *A. Paroliniana*, Webb and Bertholet. Canaries.

Hypnophila, Bourg., 1858. *A. Pupæformis*, Cantraine. 9 sp. Europe, Algiers.

Fusillus, Lowe, 1854. *A. triticea*, Lowe. 3 sp. Madeira.

Amphorella, Lowe, 1854. *A. tornatellina*, Lowe. 3 sp. Madeira.

CIONELLA, Jeffreys, 1830.

Syn.—*Styloides*, Fitz., 1833. *Cochlicopa* (part), Moquin-Tandon, 1855.

Distr.—106 sp.

Shell oblong-acuminate or ovate-oblong, striated or smooth, shining; whorls 6-7, the last rounded; aperture oval, about one-third the total length; columella short, scarcely truncated, arcuate; peristome straight, thickened within.

Zua, Leach, 1820. (*Hydastes*, Parr., 1849.) Shell ovate-oblong, imperforate, smooth, pellucid, glistening, dark horn-colored; whorls rather convex; aperture less than half the total length, ovate; columella more or less truncated; peristome blunt, its margins joined by a callus. *C. subcylindrica*, Linn. (xcix, 90). 9 sp. Europe, United States, Madeira, Sandwich Isles.

Hypselia, Lowe, 1854. *C. producta*, Lowe. 2 sp. Madeira, Morocco.

CÆCILIANELLA, Ferussac, 1817.

Syn.—*Cecilioides*, Fer., Blainv., 1817. *Polyphemus*, Parreyss, 1849. *Cæcilianella*, Bourg., 1856. *Acicula*, Risso, 1826.

Distr.—24 sp. Europe, N. Africa, Cape Verd Is., W. Indies, Mauritius. *C. acicula*, Müll. (xcix, 91).

Shell elongate, imperforate, polished, vitreous, white; spire turreted with rather obtuse apex; aperture about half the length of the shell; columella subarcuate, distinctly truncate; peristome simple, acute.

The *Cæcilianellæ* are subterranean and nocturnal in habit.

GEOSTILBIA, Crosse, 1867. Shell imperforate, small, fusiformly cylindrical, thin, hyaline; apex brusquely rounded and very obtuse; whorls few; aperture elongate-pyriform; peristome simple, slightly thickened; columellar margin with a shining, transparent, longitudinal lamina, not truncate; basal margin widely rounded. New Caledonia, India, West Indies. *C. Caledonica*, Crosse.

PYRGINA, Greef., 1882.

Distr.—*P. umbilicata*, Greef. I. of St. Thomas, W. Coast of Africa.

Shell turreted, closely wound, of twelve or thirteen whorls, in a length of 14 mill.; upper whorls with close, curved costæ, rather flat, with deep suture; last whorl with a carina and rounded basal part, with open, deep umbilicus; mouth oval, angulated; columella with a spiral fold; shell white, under a corneous epidermis.

RHODEA, H. and A. Adams, 1855.

Distr.—3 sp. New Grenada. *R. gigantea*, Mouss. (xcix, 88). Shell elongated, cylindrical, subulate, consisting of numerous

flat whorls ; last whorl concave at the base, perforated and carinated at the periphery ; aperture subquadrate, small ; columella thickened, arcuated, subtruncate below ; outer lip thin, slightly reflected.

FAMILY ACHATINELLIDÆ.

Shell small, bulimiform, dextral or sinistral, columella plicate-truncate, lip usually thickened within.

Jaw finely striated or costulated ; teeth sometimes in oblique rows, with narrow base and reflected, many-toothed margins, sometimes subhorizontal, with central and lateral teeth like *Achatina*, the marginals multicuspidate.

ACHATINELLA, Swainson, 1828.

Syn.—*Helicter* (Fer., 1819), Pease, 1862.

Distr.—300 sp. Sandwich Islands.

Shell conical, smooth, generally small, dextral or sinistral, imperforate, banded, striped and spotted with bright colors ; whorls six or seven ; columella short, callous or dentate at the base or in the middle, and very often tortuous ; aperture small ; peristome simple, not reflected, but thickened within.

Ovoviviparous. Confined to the Sandwich Islands, where they live principally among the foliage of bushes in shady places near the sea. No shells exceed these in the beauty and variety of the painting. Since the introduction of cattle into the islands they are becoming exterminated by the destruction of the foliage upon which they feed. The species being founded mostly upon the character of coloration, have been unnecessarily multiplied, as there is evidently considerable variation of coloring in the same species.

ACHATINELLASTRUM, Pfeiffer, 1854. (*Achatinella*, restricted.)
A. pulcherrima, Swains. (xcix, 73). 50 sp.

PARTULINA, Pfeiffer, 1852. Shell conical, frequently sinistral ; columella tortuous, not truncate ; outer lip thickened within, expanded. *A. pallida*, Nutt. (xcix, 72). 9 sp.

BULIMELLA, Pfeiffer, 1852. Shell conical, frequently sinistral ; columella short, not truncate ; outer lip thickened within, not expanded. *A. bulimoides*, Swains. 47 sp.

NEWCOMBIA, Pfeiffer, 1852. Shell conical, turriculated, sinistral ; whorls with revolving raised sharp lines ; columella somewhat straight, callous ; lip simple, sharp. *A. plicata*, Mighels (xcix, 78). 8 sp.

AURICULELLA, Pfeiffer, 1855. Shell subperforate, oblong-conic ; apertural paries furnished with an intrans, spiral lamella ; columella with the anterior plait dentiform or obsolete ; peritreme a little expanded. *A. auricula*, Fer. (xcix, 74). 21 sp.

FRICKELLA, Pfeiffer, 1855. Subumbilicated, oblong, conic ; a

spiral, lamellar tooth on the inner lip of the aperture; columella with a compressed fold. *A. amœna*, Pfr. (xcix, 75).

AMASTRA, H. and A. Adams, 1853. Shell generally dextral, striate or rugose, last whorl ventricose, dull-colored, brown; columella with an anterior spiral, lamelliform plication; lip slightly thickened. *A. tristis*, Fer. (xcix, 76). 22 sp.

APEX, Albers, 1860. Short conic, solid, smooth or striate; upper whorls plane, the apex acute and discolored, the others tumid, margined; aperture irregularly quadrangular, with moderate columellar tooth; the peristome thinly labiate, acute or rarely slightly expanded. *A. lugubris*, Chemn. 30 sp.

CARINELLA, Pfeiffer. Shell trochiform, carinated, coarsely striate; columella twisted and plicate; outer lip simple. *A. Kauaiensis*, Newcomb (xcix, 80).

LAMINELLA, Pfeiffer, 1852. Shell conical, turriculated; spire somewhat acute; last whorl ventricose; columella tortuous, forming a large, lamellar fold; outer lip simple, sharp. *A. picta*, Mighels (xcix, 77). 70 sp.

PERDICELLA, Pease, 1869. Shell dextral or sinistral, bulimiform, turreted or elongate-conical, imperforate, thinly striated; columella with inconspicuous or no plica; peristome simple, thin. *A. Helena*, Newcomb. 7 sp.

LABIELLA, Pfeiffer, 1852. Shell oval-conical; inner lip callous; outer lip thickened; with a callosity on the middle of its inner margin. *A. dentata*, Pfr. 6 sp.

LEPTACHATINA, Gould, 1847. Shell conical, elongated, thin; smooth, translucent; spire obtuse; aperture rounded, angular above; columella callous. *A. clara*, Pfeiffer (xcix, 79). 38 sp.

EBURNELLA, Pease, 1869. Shell solid, smooth, polished, oblong-ovate, with a twisted columellar plica; lip not thickened; apex somewhat obtuse or acute. *A. casta*, Newcomb. 9 sp.

CARELIA, H. and A. Adams, 1853.

Distr.—8 sp. Sandwich Islands. *C. cochlea*, Reeve (xcviii, 45).

Shell elongated, turriculate; whorls flattened, sometimes slightly shouldered; columella strongly arcuated and contorted; aperture small.

TORNATELLINA, Beck, 1837.

Syn.—Elasmatina, Petit, 1837. Lamellina, Pease, 1860. Lamellaria, Liardet, 1876.

Distr.—35 sp. Polynesia, Australasia, Juan Fernandez, Mauritius. *T. globosa*, Petit (c, 97).

Shell turbinate-oval or subtrochiform, fragile, pellucid; columella tortuous, truncated; columellar lip with one or several teeth; outer lip sharp, plicate within.

FAMILY CYLINDRELLIDÆ.

Shell cylindrically turriculated, many-whorled, the last whorl more or less detached at the aperture; apex of the spire usually truncated.

Jaw thin, formed of oblique plications, angular in the middle; radula narrow, the central tooth very narrow, the laterals leaf-like, oblique, the marginals sometimes resembling the laterals, but smaller, sometimes very short, rudimentary.

CYLINDRELLA, Pfeiffer, 1840.

Distr.—193 species. Tropical America.

Shell convex-cylindrical, many-whorled, truncate at the apex; whorls slowly increasing in size, the later ones frequently constricted, the last partly or wholly free, angulated or subcarinated; aperture subcircular, peristome reflected, continuous.

The true *Cylindrellæ* are chiefly represented in the islands of the West Indies. They have been distributed, with regard to the radula, in the following manner:—

Group 1. *Cylindrella* proper; only two lateral teeth on each side, the following "marginal" teeth of very different form and in various numbers. *C. Trinitaria*, Pfr., *C. gracilis*, Wood, *C. Bahamensis*, Pfr., *C. costata*, Guilding, *C. Agnesiana*, Adams, and *C. Brooksiana*, Gundlach. This division contains the groups called *Casta*, *Trachelia* and *Mychostoma* by Albers.

Group 2. *Callonia*, Crosse and Fischer: more than two lateral teeth, marginal teeth not very different; median tooth very narrow. *C. Ellioti*, Poey.

Group 3. *Thaumasia*, Albers: more than two lateral teeth; marginal teeth not differing from them. *C. perlata*, Gundl., *C. Vignalensis*, Wright, *C. brevis*, Pfr., *C. scaeva*, Gundl., *C. rosea*, Pfr., *C. sanguinea*, Pfr.

I question the propriety of separating the groups indicated above by slight differences in dentition; so few observations have been made, and the characters are also so mutable, that it appears more natural as well as more convenient to continue to employ the old subgeneric names with diagnoses made up principally from characters of the shell.

ANOMA, Albers, 1850. Shell elongated, turriculated, fusiform, subtruncated, attenuated to the summit; twelve to eighteen whorls, the last not free or declining, carinated at the base; aperture rounded-oblong, expanded in front; peristome thin, expanded. *C. tricolor*, Pfr. (xcix, 47). 14 sp. Cuba, Jamiaca, Mexico.

THAUMASIA, Albers, 1850. (*Urocoptis*, Beck [pt.], 1837.) Shell rimate, ovately cylindrical or subventricose; whorls 8-10, regularly increasing, the last scarcely free, obsoletely carinate;

peristome free, reflected. *C. decollata*, Nyst. 30 sp. Hayti, Jamaica, etc.

APOMA, Beck, 1837. (Casta, Albers, 1850.) Shell sinistral, cylindrical, subulate; whorls numerous, oblique, the last scarcely free, carinated at the base; aperture oblong, circular, peristome expanded. *C. gracilis*, Wood (xcix, 48). 3 sp. Jamaica.

CALLONIA, Crosse and Fischer, 1870. Shell subulate, truncated, many-whorled, whorls ribbed across; last whorl free, declining, angulated; aperture subquadrangular; peristome simple, expanded. *C. Elliotti*, Poey (xcix, 49). Cuba.

GONGYLOSTOMA, Albers, 1850. Shell cylindrically fusiform or conically turreted, apex attenuated, costulately striate; whorls 9-20, the last more or less protracted, narrow, sometimes obsoletely angulate; aperture circular; peristome expanded. *C. elegans*, Fer. 85 sp. Mostly Cuba and Jamaica.

MYCHOSTOMA, Albers, 1850. (Brachypus, Guild, 1828. Brachypodella, Beck, 1837. Brachypodisca, Agass., 1847.) Shell subcylindrical or subulate, truncate; whorls 9-17, the last free, declining; aperture subquadrangular; peristome expanded. *C. collaris*, Fer. (xcix, 51). 27 sp. West Indies.

STROPHINA, Mörch, 1852. Shell turriculated, cylindrical, subventricose, umbilicated, summit truncate; whorls convex, obliquely plicate; columella angulated at the base; subarcuated; aperture subquadrangular. *C. Laterradii*, Grat. (xcix, 52). Hayti.

CIRROBASIS, Conrad, 1874. *C. venusta*, Conr. (xcix, 53). Tertiary. Pebas, Upper Amazon.

TRACHELIA, Pfeiffer, 1855. (Acera, Ads. [pt.], 1855.) Shell fusiform, not rimate, apex attenuate, somewhat truncated; whorls 18-24, the last free, protracted; aperture oblique, circular; peristome expanded. *C. porrecta*, Gould (xcix, 50). 33 sp. Cuba, and other W. I. Islands, Central America.

METASTOMA, Strebel and Pfeffer. Not truncated; last whorls partly free, turned horizontally inwards, concealing the perforation. *C. Roëmeri*, Pfr. Mexico.

BOSTRICHOCENTRUM, Strebel and Pfeffer. Columella tubular, surrounded by a thick, solid, rope-like thickening. *C. Tryoni*, Pfr. (xcix, 54). Mexico.

HOLOSPIRA, Martens, 1860. (Acera, Albers, 1850.) Shell rimate, turreted or fusiform, apex conical, *not* truncated; whorls 11-14, the last barely or not at all protracted, base carinated; columella plicate; aperture quadrangular; peristome free, expanded. Erected by Crosse and Fischer into a distinct genus in the family Pupidæ, the teeth of the radula being in transverse rows and tricuspidate, similar to *Helix*; the jaw very thin and smooth. *C. Pfeifferi*, Menke; Texas, Mexico. 13 sp. Mexico, Texas, on Cactus.

EPIROBIA, Strebel and Pfeffer. Distinct from *Holospira* by the columella being perpendicularly costulated, but without spiral plait. *C. Berendti*, Pfr. Mexico.

EUCALODIUM, Crosse and Fischer, 1868. Shell subrimate, turreted, cylindrelliform, widely truncate; last whorl slightly free, more or less carinate; columella with a plica, not reaching the aperture. Jaw arched, finely striated, with a short laminar appendix, recalling that of *Succinea*; teeth of the radula in transverse rows, tricuspidate, similar to those of *Helix*. *C. Ghiesbreghti*, Pfr. (xcix, 55). 20 sp. Mexico.

ANISOSPIRA, Strebel and Pfeffer. Shell somewhat like *Eucalodium*, columella tubular with external plait. *C. Liebmanni*, Pfr. (i, 12, 13).

CELOCENTRUM, Crosse and Fischer, 1872. Pillar a hollow glossy tube; shell resembling *Eucalodium*, externally ribbed. *Cylindrella turris*, Pfr. (xcix, 56). 8 sp. L. California, Mexico, Guatemala.

BERENDTIA, Crosse and Fischer, 1869. Shell turriculated, dextral, with obtuse summit and numerous whorls, the last one descending and detached in front; peristome continuous, widely reflected; columella simple, without lamellæ; aperture semi-circular, without plications; no clausilium; umbilicus deeply slit.

General shape of shell like *Clausilia*, but without plaits or clausilium in the interior; jaw very arcuate, with nine strong ribs; radula with a somewhat smaller tricuspid median tooth and thirty lateral and marginal teeth, the first tricuspid, the latter bicuspid. Except the jaw, there are many points of resemblance between *Berendtia* and *Eucalodium*. *C. Taylora*, Pfr. (*C. Newcombiana*, Gabb.) Lower California.

FASCINELLA, Stache, 1870.

Distr.—*F. eocenica*, Stache. L. Eocene; Albona.

Shell smooth, thin, turriculated, small; axis perforated; spire sharp; last whorl small, retracted; columella plicate, the extremities of the lip united upon it by a callosity.

LEIA, Albers, 1850.

Syn.—*Lia*, Mörch, 1852.

Distr.—8 sp. Jamaica, Hayti. *L. Maugeri*, Wood (xcix, 57).

Shell very smooth, shining, subfusiform-cylindrical, apex truncate; eight whorls, the last contracted below, carinated at the base; aperture oblong; columella plicate; peristome not continuous, reflected. The peculiar porcellaneous surface of *Leia* will distinguish it at once from *Cylindrella*.

PINERIA, Poey, 1854.

Distr.—4 sp. West Indies. *P. Viequensis*, Pfr. (xcix, 58).

Shell imperforate, conically turreted, obliquely plicate; whorls

7-8, somewhat tumid; aperture depressly rounded; peristome thin, simple, margins approximating. Jaw and radula as in *Cylindrella*; inferior tentacles atrophied.

MACROCERAMUS, Guilding, 1828.

Syn.—*Leptospira*, Swains., 1840. *Colobus*, Albers, 1850.

Distr.—50 sp. West Indies and adjoining Continent. *M. Jeannereti*, Gundl. (xcix, 59).

Shell oval or cylindrically turreted, apex more or less obtuse; whorls numerous, the last subangular; aperture subcircular; peristome thin; lips approaching, the columellar lip dilated and reflected.

The animal has a short foot; inferior tentacles rudimentary; jaw similar to *Cylindrella*, very finely plicate; radula elongated, the central tooth small, obtuse, laterals and marginals similar, palmiform, with elongated bifid internal cusps.

The shell has usually a porcellaneous white surface, here and there spotted and striped with brown and ash-color.

Mr. Bland believes *Pupa vetusta*, a carboniferous fossil of Nova Scotia, to have belonged to this genus: Fischer has made for it a section of *Pupa*, which he calls *Dendropupa*.

FAMILY PUPIDÆ.

Shell generally minute, multispiral, cylindrical, with obtuse summit (Pupiform); aperture small, usually contracted by internal teeth or lamellæ.

Jaw smooth or finely striated, sometimes with a superior appendage resembling that of *Succinea*; radula resembling *Helix*, the central and lateral teeth similar, tricuspid, the marginals transverse, very short and denticulated.

PUPA, Lam, 1801.

Syn.—*Cochlodonta*, Fer., 1820. *Cochlodon*, Lowe.

Distr.—377 sp. Universal, boreal and tropical. Fossil, 50 sp. Carb., N. America; Eocene—, Europe.

Usually very small, cylindrical or oval-oblong; umbilicus slight or a mere slit; plicate, striate or costellate, brown or horn-color; columella plicate or subdentate; lip reflected, usually dentate or plicate within, the extremities usually joined by a raised callus.

Animal with a short foot, pointed behind; lower tentacles short.

ANOSTOMELLA, Martens, 1867. Shell small, short egg-shaped, ribbed, epidermis brown; lip expanded, without teeth. *P. ascendens*, Martens. Amboina.

TORQUILLA, Stud., 1820. (*Chondrus*, Hartmann, 1821. *Granaria*, Held, 1837. *Alloglossa*, Lindström.) Shell oval-oblong or

fusiform, turriculated, the apex somewhat sharp; aperture oval-oblong, multiplicate, sometimes edentulate; peristome expanded or reflected. *P. polyodon*, Drap. (c, 1, 2). 62 sp. Europe, N. Africa.

ABIDA, Pfr., 1878. *P. variabilis*, Drap. According to Lindström, the dentition of *P. avenacea*, Brug., resembles that of the Auriculidæ.

TOMIGERELLA, Pfr., 1878. *P. soluta*, Pfr.

MODICELLA, H. and A. Adams, 1855. Shell oblong-fusiform, striate or smooth; spire elevated conic; whorls slightly convex; aperture semi-oval, without teeth; peristome simple, or with a callous tubercle near the outer lip. *P. Farinesi*, Desm. (c, 3, 4).

CHARADROBIA, Albers, 1852. (*Leiostyla*, Lowe, 1852. *Mastula*, Lowe, 1852. *Rheinhardtia*, Böttger.) Shell narrowly umbilicated, elongated or cylindrical; aperture with many plicæ, transverse; peristome thin. *P. recta*, Lowe. 17 sp. Madeira, Azores, one European species (*P. anglica*, Fer.).

CRATICULA, Lowe, 1854. (*Charadrobia* [pars], Albers.) *P. ferraria*, Lowe. 4 sp. Madeira.

ORCULA, Held, 1837. (*Eruca*, Swains [pt.], 1840. *Gibbulina*, Drouet [pt.], 1855.) Shell oval-cylindrical; aperture semioval; columella more or less plicate, columellar lip unilamellose, peristome thin or slightly thickened, reflected. *P. doliolum*, Brug. (c, 5). 10 sp. Southern Europe.

SCARABELLA, Lowe, 1854. (*Eryma*, Albers, 1854. *Odontocyclas*, H. and A. Adams [pt.], 1855.) Shell subperforate, ovate, rather solid, costulate, variegated with chestnut; whorls eight, the last subcompressed at the base; aperture triangularly oval, with two parietal plicæ, two on the columella, and three on the outer lip; peristome slightly expanded. *P. cassida*, Lowe. 3 sp. Madeira.

ODONTOCYCLAS, Schlütter, 1838. (*Scopelophila*, Albers, 1850. *Eryma*, Albers, 1850.) Shell subperforate or rimate, conical or oval, striated; spire conic, summit obtuse; whorls slightly convex, the last compressed at the base, sometimes ascending; aperture triangularly rounded, many-toothed; peristome simple, a little expanded. *P. Rossmassleri*, Schmidt. *P. Kokeilii*, Rossmassler. 3 sp. So. Eastern Europe, Himalaya Mts.

PAGODELLA, H. Ad., 1867. Shell rimate, ovate, opaque; whorls convex; aperture semioval, with two parietal plicæ, and a thin, nearly direct peristome, the margins of which are callously connected. *P. ventricosa*, H. Ad. 2 sp. Mauritius, Isle of Bourbon.

INFUNDIBULARIA, Pfr., 1876. *P. infundibuliformis*, Orb. Bolivia.

ALVEARELLA, Lowe, 1853. Shell oval, smooth or striated; spire convex, apex obtuse; whorls convex, the last contracted at

the base; aperture subtriangular, oblong, toothed; peristome callous, reflected. *P. Sturmii*, Küster. 4 sp. Natolia, Madeira.

LEUCOCHILA, Martens, 1860. Cylindrically ovate, apex somewhat obtuse, smooth, pellucid, shining; aperture semioval, edentulous, or armed with teeth or plications; lip thickened, reflexed, rimate. *P. fallax*, Say. *P. armifera*, Say (c, 6). 8 sp. United States, West Indies.

SPHYRADIUM, Agassiz, 1837. Shell rimate or umbilicate, oblong, obconic, apex obtuse, pallid corneous, costulate; whorls 6-8, rather flat, the last compressed; aperture edentulous or few-plicate; outer lip incurved in the middle. *P. truncatella*, Pfr. 10 sp. Southern Europe, Caucasus, Himalaya Mts.

PAGODINA, Stabile, 1864. (Pagodulina, Clessin.) *P. pagodula*, Desm. Europe.

PUPISOMA, Stoliczka. Shell subconic or ovate, thin, corneous, the cuticle transversely striate; aperture edentulous; columellar lip somewhat expanded, internally twisted, often with a small tooth. 2 sp. *P. lignicola*, Stol. Penang.

DENDROPUPA, Fischer, 1883. *P. vetusta*, Dawson. Carboniferous; Nova Scotia. There are a number of tertiary species.

ANTHRACOPUPA, Whitfield, 1881. *P. Ohioensis*, Whitfield. Carb.; Ohio.

LAURIA, Gray, 1840. (Gastrodon, Lowe, 1854.) Peristome margined, reflexed; the young shell with a transverse series of short, triangular plaits, disappearing in the later whorls. *P. umbilicata*, Drap. 4 sp. Europe, Madeira, Teneriffe, Abyssinia.

PUPILLA, Leach, 1820. (Torquatella, Held, 1837. Paludinella, Lowe, 1854. Odostomia, Moquin-Tandon, 1855.) Cylindrical, apex obtuse; whorls 5-9, corneous, somewhat shining; aperture rounded, lip expanded, scarcely reflected, armed with teeth or without teeth. *P. biplicata*, Mich. (c, 7, 8). 77 sp. Universal, mostly European, Indian and North American.

VERTIGO, Müller, 1774.

Syn.—Pupella, Swains., 1840. Mastula and Staurodon, Lowe, 1852.

Distr.—100 sp. Universal. Fossil. Liassic? Miocene—.

Shell minute, rimate, oval, frequently sinistral, apex obtuse; whorls five or six, striate or plicate; aperture irregular, multi-dentate; peristome expanded, with white lip.

Animal without inferior tentacles; jaw nearly smooth or longitudinally wrinkled, subrostrate in the middle; marginal teeth saw-like.

ALÆA, Jeffreys, 1830. (Isthmia, Moquin-Tandon, 1855. Dextrogyra, Stabile, 1864.) Shell cylindrical; aperture denticulate or multilamellate; peristome simple. *V. antivertigo*, Drap. (c, 11,

12). 85 sp. Europe, N. Africa, East and West Indies, Polynesia, United States.

VERTILLA, Moquin-Tandon, 1855. *V. pusilla*, Müll. (c, 13). 15 sp. Europe, Australia, Sandwich Isles, etc.

ISTHIA, Gray, 1821. (Truncatellina and Paludellina, Lowe, 1852. Edentulina, Clessin.) Shell cylindrical, summit obtuse, striated, whorls flattened; aperture semioval, edentulous; lip thin, slightly reflected. *P. columella*, Mart. (c, 9, 10). 27 sp. Europe, Africa, etc.

FAULA, H. and A. Adams, 1855. (Fauxulus, Schauf., 1869.) Shell sinistral, oval-conic, smooth; spire conical or subcylindrical, apex pointed; whorls flattened, the last narrowed towards the base; aperture semioval, plicate within the outer and on the parietal wall; peristome simple. *P. Capensis*, Kurr. (c, 100). 3 sp. Cape of Good Hope.

ZOSPEUM, Bourg., 1856.

Distr.—10 sp. Caverns in Carniola and Spain. *Z. spelæum*, Rossm. (c, 14).

Shell minute, subhyaline, pupiform, umbilicated, spire obtuse; aperture usually with columellar and parietal plicæ, sometimes edentulous.

The members of this group are met with in caverns and other places from whence the light is excluded. Bourguignat, in consequence, supposes that they are without the usual organs of vision; four tentacles. The position of this genus is somewhat doubtful; some conchologists are inclined to place it near Carychium, which its radula resembles.

STROPHIA, Albers, 1850.

Syn.—Cerion, Mörch, 1852.

Distr.—35 sp. West Indies, Florida, Bahamas. *S. uva*, Linn. (c, 15). *S. chrysalis*, Fer. (c, 16).

Shell large, pupiform, or cylindrical, with obtuse apex; striate or costate, rimate; aperture oval, with plicate columella and expanded lip.

Inferior tentacles very short; jaw finely striated with a median projection; dentition resembling *Helix*.

MEGASPIRA, Lea, 1834.

Syn.—Pyrgelix, Beck, 1837.

Distr.—2 sp. Forests of Brazil. Fossil, Eocene of Paris basin. *M. elatior*, Spix (c, 17).

Shell elongated, attenuated to an obtuse apex, multispiral; whorls about twenty-five in number, flattened, slowly increasing, costulate; aperture small, rounded, angular behind; columella with transverse dentiform plications; peristome simple.

CÆLIAXIS, Adams and Angas, 1855.

Distr.—2 sp. Cape of Good Hope, Solomon's Is. *C. exigua*, Ads. and Angas (c, 18).

Shell dextral, umbilicated, turreted, obliquely costulate; spire usually decollate; whorls numerous; aperture with a parietal plica or tubercle, a subcolumellar plication, and a columellar lamella not visible from without; peristome simple, continuous.

PERRIERIA, Tapparone-Canefri, 1879.

Distr.—*P. Clausiliæformis*, Tapparone. New Guinea.

Shell sinistral, many-whorled, truncated at the apex; aperture elliptical; peristome continuous; columella twisted, dentately truncate below.

Approaches Clausilia, but differs by its truncated spire and columella and want of plications.

RILLYA, Munier-Chalmas, 1883.

Distr.—Eocene; Paris. Type, *Pupa Rillyensis*, Desh. -

Shell sinistral, fusiform, ventricose, apex not decollated, sharp; aperture simple or dentate; subcolumellar plication joining a columellar lamella largely developed in the interior, peristome reflected.

CLAUSILIA, Draparnaud, 1805.

Etym.—Diminutive of *clausum*, a closed place.

Syn.—Cochlodina, Fer., 1819.

Distr.—700 species and varieties. Europe (mostly southern and southeastern), Asia (mostly southern and western), Africa, West Indies (1 sp.), South America. Fossil, 20 sp. Carb.; Nova Scotia. Eocene—; Gt. Britain, France. *C. maxima*, Grat., miocene of Dax, is 2 inches long.

Shell fusiform, usually sinistral; aperture elliptical or pyriform, with a posterior sinus, contracted by lamellæ, and closed when adult by a movable shelly plate (clausilium) in the neck; peristome continuous, reflected.

Animal with a short, obtuse foot; upper tentacles short, lower very small; respiratory and genital orifices on the left side; jaw with finely sillonated surface; radula like *Helix*. *C. bidens* has 120 rows of 50 teeth; *C. nigricans*, 90 rows of 40 teeth each.

A peculiar and characteristic feature of the present genus is that the animal is provided with an internal process called the "*clausilium*" (iii, 42), which acts as a valve or spring-door in closing the shell against all intruders, and has been first well described by Mr. J. S. Miller, in the "Annals of Philosophy" for 1822 (vol. iii, p. 378), in the following words:—

"Independently of the various contrivances which nature has resorted to for the protection of the otherwise vulnerable mollusca, it has taken peculiar care to guard the apertures of many

univalves from the intrusion of enemies; hence the apertures are sometimes contracted and provided with numerous folds and teeth. Other mollusca have a calcareous operculum permanently formed, which increases in thickness, and enlarges on a depressed spiral plane, as the opening of the shell extends with the growth of the animal, thus continually assimilating to its size, and when the animal retreats, excluding it completely from all external intrusion. In the *Clausilia* nature has continued the protection afforded by means of contractions and folds, and also added an opercular appendage. The inhabitant of the *Clausilia*, when nearly full-grown, secretes a thread-like elastic calcareous filament, one of whose ends is affixed to the columella. This filament makes half a spiral turn round the columella, insinuating between its folds. When the animal finishes its shell and completes the aperture, it secretes, at the unattached end of the filament, a spoon-shaped calcareous lamina conforming at its margin to the contour of the aperture. The lamina is somewhat smaller than this, and its margin is rounded. Its adhesion to an elastic filament enables the animal to push it, when it comes out of the shell, against the columella; and the same elasticity closes it on the inhabitant retreating, thus securing it from intruding enemies. Thus, then, this valve may be compared to a door provided with an elastic spring. The elasticity of the filament may be restored to its full power (in the empty shell) by sometimes immersing it in water, as I have ascertained in a section made with a view to this inquiry."

The following arrangement of the subgenera or sections of *Clausilia* is essentially that of O. Böttger, who has devoted much time and attention to the study of the systematic relationship of the species.

BALEA, Prid., 1824. (*Baleastra*, Pfr., 1855. *Tristania*, Böttg., 1878. *Pseudobalea*, Shuttl., 1854.) Shell thin, spiral, turriculated, sinistral; aperture rounded in front, angular behind, without lunule; columella simple or uniplicate; no clausilium. *C. Tristensis*, Leach, and *C. perversa*, L. (c, 20). Europe, Tristan d'Acunha, New Zealand. The want of posterior lunule or bay of the aperture and of a clausilium, makes this an aberrant form, and it has sometimes been considered a distinct genus; it is united to the typical *Clausilia*, however, through the group *Alopiia*, Adams, in which the clausilium is sometimes absent, sometimes more or less developed.

TEMESA, H. and A. Adams, 1855. Columella plicate at the base. *B. Clausilioides*, Reeve (c, 19). Peru.

DACTYLUS, Sandberger, 1870. (*Filholia*, Bourg., 1877.) Shell very large, with pear-shaped aperture, continuous peristome, and columella with a basal lamella. *Bulimus lævolongus*, Boubée. Fossil. Lower Tertiary; Europe.

REINIA, Kobelt. *C. variegata*, A. Adams. Japan. Shell bulimiform.

TRIPTYCHIA, Sandb. (Milne-Edwardsia, Bourg.) Shell large, subfusiform; columellar lamella and plication subparallel, continuous for a number of whorls; parietal lamella more or less developed; the other plicæ of Clausilia are absent. Clausilium? *C. antiqua*, Schubl. Only fossil species, miocene, and a few pliocene.

ALLOPIA, H. and A. Ad., 1855. (Attica, Böttger, 1877.) Shell dextral, thin, livid, more or less plicate, without lunule; internal plicæ numerous; spiral lamella disjoined; last whorl rounded at the base; peristome continuous. *C. Guicciardi*, Held, and *C. livida*, Mke. Attica and Transylvania.

EUALOPIA, Böttger, 1877. Only fossil species, miocene. *C. bulimoides*, A. Braun.

TRILOBA, Vest, 1867. (Macedonica, Böttg., 1877.) *C. Sandrii*, Kust., and *C. Macedonica*, Rossm. (c, 21, 22). Montenegro and Macedonia.

MARPESSA, Moq.-Tand. (emend.), 1855. (Dyodonta, Hartmann, 1844.) Shell usually smooth, shining, corneous, the last whorl slightly compressed; aperture rounded at the base; four parietal plications usually; no lunule. *C. transiens*, Mollend., and *C. laminata*, Mont. Europe.

HERILLA, H. and A. Adams (emend.), 1855. (Turcica, Böttg., 1877.) Smooth, shining, corneous, generally thin; lunule more or less perfect; spiral lamella disjoined; inferior internal plications visible. *C. Friwaldskiana*, Rossm., and *C. Dacica*, Friv. European Turkey, Servia and Dalmatia.

SICILIARIA, Vest, 1867. (Trinacria, Böttg., 1877.) *C. septemplicata*, Phil. (c, 23), and *C. crassicostata*, Ben. Sicily.

DELIMA, Hartm., 1844, (emend.). (Subsections: Gibbula, Stigmatica, Piceata, Itala, Tirolica, Dalmatica, Binodata, Lævissima, Albanica, Montenegrina, Substricta, Robusta, Semirugata, all of Böttger, 1877.) Corneous, shining, more or less pellucid; plication external; spiral lamella disjoined. *C. gibbula*, Ziegl. *C. stigmatica*, Ziegl. *C. piceata*, Ziegl. *C. Itala*, Mart. *C. Stentzi*, Rossm. *C. conspurcata*, Jan. *C. binodata*, Ziegl. *C. lævissima*, Ziegl. *C. Cattaroensis*, Ziegl. *C. substricta*, Parr. *C. robusta*, Küst., and *C. semirugata*, Küst. Dalmatia, southeastern parts of the Alps, Italy.

MEDORA, H. and A. Ad., 1855 (emend.). Whitish or bluish; lunule more or less perfect; peristome continuous, free, sometimes advanced. *C. macarana*, Ziegl. Dalmatia, Carniolia, Calabria.

AGATHYLLA, H. and A. Ad., 1855 (emend.). Grayish, costulate; lunule none or imperfect; spiral lamella disjoined; one to three internal plications. *C. exarata*, Ziegl. (c, 24). Dalmatia, Bosnia.

CONSTRUCTA, Böttg., 1877. *C. tenuisculpta*, Reuss. All miocene species.

CRISTATARIA, Vest, 1867. *C. strangulata*, Fer. Syria, Palestine, Crete, Macedonia.

ALBINARIA, Vest, 1867. (Subsections: Filumna, Cretica, Striata, Egana, Sericata, Profuga, Lampedusa, Bigibbosa, Archipelagica, Mirabellina, Corrugata, Interstriata, Teres, Munda, Scopulosa, Laconica, Cerigana, Graja, Nævosa, all of Böttger, 1878.) *C. cærulea*, Fer. Greece and its islands, Asia Minor.

CARINIGERA, Möllend., 1873. Neck provided with a keel, which runs parallel to the lamella. *C. eximia*, Möllend. Servia.

PAPILLIFERA, Hartm., 1844 (emend.). (Papillina, Moquin-Tandon, 1855. Subsections: Isabellaria, Vest, 1867. Venusta, Böttger, 1877. Euclista, Böttger, 1878.) Corneous; lunule perfect; no internal plications nor spiral lamella. *C. lampedusæ*, Calc. *C. Isabellina*, Pfr. *C. venusta*, A. Schm. *C. Græca*, Pfr. *C. leucostygma*, Ziegl. *C. saxicola*, Parr. *C. solida*, Drap., and *C. bidens*, L. (c, 25, 26). Italy and Greece.

DILATARIA, Vest, 1867. (Subsections: Banatica, Böttger, 1877. Charpentieria, Stabile, 1864.) *C. tenuilabris*, Rossm. *C. succinea*, Ziegl., and *C. diodon*, Stud. Austrian provinces and Piedmont.

PHÆDUSA, H. and A. Ad., 1855. (Subsections: Euphædusa, Pseudonenia, Stereophædusa, Formosana, Megalophædusa, Oospira, Acrophædusa, Cylindrophædusa, Hemiphædusa, all of Böttger, 1877.) Shell smooth, more or less solid, yellowish or corneous; lunule obsolete or none; spiral lamella generally disjoined; last whorl rounded at the base; peristome continuous, free. *C. Shanghaiensis*, Pfr. *C. valida*, Pfr. *C. Yokohamensis*, Crosse. *C. Swinhoei*, Pfr. *C. Philippiana*, Pfr. *C. cornea*, Phil. *C. cylindrica*, Gray. *C. Cochinesis*, Pfr. (c, 27). *C. pluviatilis*, Bens. Eastern Asia.

SERRULINA, Mouss., 1873. (Subsection: Filosa, Böttger, 1877.) *C. serrulata*, Midd. *C. filosa*, Mouss. Transcaucasia.

FUSULUS, Vest, 1867. *C. interrupta*, Ziegl. *C. varians*, Zieg. S. E. Germany.

PSEUDALINDA, Böttger, 1877. (Subsection: Mira, Böttger, 1877.) *C. fallax*, Rossm. (c, 28, 29). *C. mirabilis*, Parr. Transylvania and Asia Minor.

UNCINARIA, Vest, 1867. *C. turgida*, Zieg. Transylvania and Bukovina.

MENTISSOIDEA, Böttger, 1877. *C. fusorium*, Mouss. Transylvania.

MENTISSA, H. and A. Ad., 1855 (emend.). (Subsections: Index, Polyptychia, Galeata, Strumosa, Mucronaria, Acroeuxina, Quadriplicata, Megaleuxina, Caucasica, Laciniaria, all of Böttger,

1877.) More or less smooth, corneous; lunule obsolete; last whorl with a basal crest. *C. gracilicosta*, Ziegl. Crimea.

EMARGINARIA, Böttger, 1877. *C. Schæfferiana*, Böttger. Miocene.

CANALICIA, Böttger, 1863. *C. articulata*, Sandb. All species miocene.

EUXINA, Böttger, 1877. *C. Duboisi*, Charp. *C. Schwerzenbachi*, Parr. *C. strumosa*, Friv. *C. acuminata*, Mouss. *C. hetæra*, Friv. *C. Huebneri*, Rossm. *C. Sandbergeri*, Mouss. *C. Somchetica*, Pfr. *C. mæsta*, Fer. Crimea, Transcaucasia, Asia Minor, Syria.

ALINDA, H. and A. Ad., 1855 (emend.). (Iphigenia, Gray, 1840.) Lunule perfect; spiral lamella disjoined; internal plications numerous; last whorl compressed; aperture canaliculate at the base. *C. biplicata*, Mont. *C. plicata*, Drap. *C. index*, Mouss. Transcaucasia.

STRIGILLARIA, Vest, 1867. *C. cana*, Held. Germany and S. E. Europe.

PSEUDIDYLA, Böttger, 1877. *C. Maersingensis*, Sandb. Only two miocene species.

IDYLA, H. and A. Ad., 1855 (emend.). (Subsections: Bitorquata, Bulgarica, Böttger, 1877.) Lunule distinct; plications few or obsolete; last whorl presenting at the base a large single or double crest; aperture more or less canaliculated. *C. pagana*, Ziegl. *C. bitorquata*, Friv. *C. Varnensis*, Pfr. S. E. Europe and Syria.

OLIGOPTYCHIA, Böttger, 1877. (Crucita, Westerlund, 1878. Subsections: Armenica, Scrobifera, Hellenica, Böttger, 1877.) *C. lævicollis*, Parr. *C. foveicollis*, Parr. *C. Pikerimiana*, Roth. Greece, Transcaucasia, Asia Minor and Syria.

PIROSTOMA, Vest, 1867 (emend.). (Plicaphora, Hartmann, 1844. Macrogastra, Strobil, 1850. Elia, H. and A. Adams, 1855, part. Subsections: Erjavecica, Brusina, 1870 [Trigonostoma, Vest, 1867]. Kuzmicia, Brus., 1870 [Iphigenia, Westerlund, 1878]. Graciliaria, Bielz., 1867.) *C. Bergeri*, Meyer. *C. rugosa*, Drap. *C. plicatula*, Drap. *C. ventricosa*, Drap. (c, 30). Europe.

LAMINIFERA, Böttger, 1863. (Tortula, West.) *C. Pauli*, Mabilie. *C. rhombostoma*, Böttger. Pyrenees. Miocene and one oligocene species.

NENIA, H. and A. Ad., 1855. Costellate or striate; no lunule; plication simple, superior; spiral lamella continuous; last whorl rounded at the base, produced; aperture in the axis of the shell; peristome continuous, reflected. *C. Blandiana*, Pfr. *C. cyclostoma*, Pfr. *C. tridens*, Chem. (c, 31). *C. Bartletti*, H. Ad. *C. perarata*, Martens. *C. Bourcieri*, Pfr. New Grenada, Ecuador, Peru and Porto Rico.

NENIATLANTA, Bourg. Peristome feeble; under lamella parallel to the upper. 2 sp. Pyrenees.

DISJUNCTARIA, Böttger. *C. oligogyra*, Böttger. Eocene.

MACROPTYCHIA, Böttger. *C. Sennaariensis*, Pfr. N. E. Africa.

BOETTGERIA, Heynem., 1861. *C. crispa*, Lowe, and *C. deltostoma*, Lowe. Madeira.

OLYMPIA, Vest, 1867. *C. Olympica*, Friv. Mt. Olympus.

FAMILY LIMACIDÆ.

Shell rudimentary, a calcareous plate, not spiral, concealed under the mantle, and covering the respiratory cavity. Foot with or without mucous pore; jaw oxygnathous, arcuated, without ribs, with a rostriform projection on the inferior margin (xiii, 62); lingual plate with tricuspidate central tooth, the middle cusp long and narrow, laterals bi- or tricuspidate, marginals narrow, sharp uni- or bicuspidate (xiii, 61). The slugs are often crepuscular in their habits and are chiefly herbivorous, although sometimes taking decaying animal substances. They inhabit woods and gardens, coming forth after showers or when the dew is on the ground. In the United States several species are commonly found in the cellars of houses. Some of the limaces occasionally climb small trees or bushes and suspend themselves from the branches or leaves by a glutinous thread.

For the generic descriptions of the slugs of this and the following families I am indebted to Mr. William G. Binney, of Burlington, N. J., to whom I am also under many obligations for advice upon the treatment of some of the shell-bearing pulmonates.

LIMAX, Linn., 1758.

Distr.—100 sp. Universally distributed. *L. alpinus*, Fer. (ci, 56). *L. Lartetii*, Dupuy (ci, 57).

Animal attached its whole length to the foot, subcylindrical, tapering behind, bluntly truncate anteriorly; tentacles simple; mantle small, anterior, enclosing a shelly plate; no longitudinal furrows above the margin of the foot, nor caudal mucous pore; a distinct locomotive disk; external anal and respiratory orifices at the right posterior margin of the mantle; orifice of combined generative organs behind and below the right peduncle.

Shell-plate testaceous, thin, flat, longer than wide, with concentric striae of increase, internal.

Jaw smooth, with median projection. Lingual membrane long and narrow; central teeth tricuspid, laterals bicuspid, marginals aculeate, often bifid. Considerable variation is found in the dentition of the genus; the centrals and laterals are sometimes unicuspid.

The following generic and subgeneric names have been sug-

gested for species of *Limax*, founded mostly on the peculiarities of the mantle, genitalia and lingual dentition: *Eulimax*, *Agriolimax*, *Milax* (Gray), *Amalia*, *Lehmannia*, *Limacus* (Lehmann), *Krynckellus*, *Krynckia*, *Heynemannia*, *Plecticolimax*, *Hydrolimax*, *Lallemannia* (Mabille), *Malino* (Gray), *Malinastrum*, *Gestroa*, *Chromolimax*, *Opilolimax*, *Stabilea*, *Malicolimax*, *Megapelta* (Mörch), *Clytropelta*, *Ibyeus*.

AMALIA, Moquin-Tandon, 1855. (*Milax*, Gray, 1855.) Mantle more or less rugose, no concentric striæ; tail strongly carinated; shell-plate with median nucleus. *L. Sowerbyi*, Fer.

EULIMAX, Moquin-Tandon. Mantle with more or less distinct concentric striæ, no rugosities. *L. alpinus*, Fer. (ci, 56). *L. gagates*, Drap. (ci, 58).

MALINO, Gray. Back keeled; dorsal shield large, front half concentrically, hinder longitudinally furrowed, very contractile, very mobile, moving rapidly from side to side as the animal walks. *M. lumbricoides*, Morelet.

KRYNICKIA, Kalenicz. Shield very large, only adhering behind; body slender; respiratory orifice on the right posterior margin of the mantle. *L. brunneus*, Drap. *Megapelta*, Mörch, a Central American group, is very similar. *L. semitectus*, Mörch.

PARMACELLA, Cuv., 1805.

Syn.—*Girasia*, Drusia, Gray (part).

Distr.—Around Mediterranean, Canaries, Central Asia. *P. Valenciennesi*, Webb (c, 41).

Animal limaciform, subcylindrical, swollen behind, gradually attenuated before; tentacles simple; mantle large, central, concealing the shell; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; distinct locomotive disk? external respiratory and anal orifices at the right posterior margin of the mantle; orifice of the combined generative organs behind and below the right eye-peduncle.

Shell small, testaceous, internal, rudimentary, subspiral, aperture very large, dilated anteriorly.

Jaw smooth, with a median projection. Lingual membrane with tricuspid centrals, first laterals tricuspid also, marginals aculeate.

The young animal is entirely enclosed in the shell, which is furnished with a sort of operculum. As the animal grows the operculum falls, the shell becomes covered with the mantle, and only increases at its outer margin, like the simple shell-plate of *Limax*.

CRYPTELLA, Webb and Bertholet, 1833. Canary Islands. Shell less distinctly spiral.

During eight or nine months in the year their vital activity is suspended, and they remain concealed under the large blocks of

lava with which these islands are covered; they are herbivorous, and during the rainy season, especially in the night, they quit their retreats and commit great havoc in the gardens. The peasants destroy them by thousands, but, notwithstanding this persecution, their numbers do not appear to diminish.

PHOSPHORAX, Webb and Bertholet, 1838.

Distr.—*P. noctilucens*, W. and B. (ci, 61). Teneriffe.

Animal limaciform, swollen at middle; tentacles simple; mantle large, anterior, with a posterior, small, phosphorescent disk, and concealing a shell-plate; no longitudinal furrows above the margin of foot and no caudal mucous pore shown in the plate; distinct locomotive disk? external anal and respiratory orifices on right anterior margin of mantle; generative orifice? Internal shell-plate thick, oval, testaceous. Jaw? Lingual membrane? Teneriffe. A doubtful genus, so little do we know of it. It is impossible to ascertain its systematic position.

MARIAELLA, Gray, 1855.

Syns.—Tennentia, Humbert, 1862. Clypeicella, Val.

Distr.—5 sp. Philippines, Seychelles Is. *M. Dussumieri*, Gray (xcii, 78).

Body limaciform, subcylindrical, attenuated behind; tentacles simple; mantle large, anterior, concealing the shell; longitudinal furrows above the margin of the foot, meeting over a linear caudal mucous pore; distinct locomotive disk; external respiratory and anal orifice on the right central margin of mantle; orifice of combined genital system behind and below the right eye-peduncle.

Shell internal, small, rudimentary, convex above, flat below, apex on right posterior side, recurved.

Jaw smooth, with median projection. Lingual membrane with tricuspid centrals and laterals, and aculeate, bifid marginals, in the typical species; others vary.

The swollen central portion of the animal seems the first approach to a turbinate mass of viscera, separated from the foot.

PARMARION, Fischer.

Syn.—Girasia, Gray (in part), 1855.

Distr.—10 sp. Java, India. *P. papillaris*, Humb. (ci, 58, 59).

Animal limaciform, subcylindrical, tapering behind; tentacles simple: mantle large, anterior, enclosing an internal shell-plate, which is partially exposed by a posterior opening; distinct locomotive disk? longitudinal furrows above the margin of the foot and caudal mucous pore, over which is a horn-shaped process; external, anal and respiratory orifices on the posterior right

margin of mantle (see von Martens' figure of *P. papillaris*); orifice of combined genital system?

Shell-plate internal, rudimentary, flat, with a side nucleus.

Jaw smooth, with a median projection.

Lingual membrane with tricuspid centrals, bicuspid laterals, and aculeate, bifid marginals.

UROCYCLUS, Gray, 1864.

Distr.—Mozambique, Prince's Isle, etc. *U. Kirkii*, Gray (ci, 60).

Animal limaciform, subcylindrical, blunt before, tapering behind; tentacles simple; mantle small, anterior, with a posterior opening, and concealing an internal shell-plate; longitudinal furrows above the margin of the foot and caudal mucous pore; a distinct locomotive disk; external respiratory and anal orifices on the right slightly anterior margin of the mantle; orifice of combined generative organs behind and below right eye-peduncle.

Shell-plate internal.

Jaws smooth, without median projection.

Lingual membrane with tricuspid centrals, bicuspid laterals, aculeate and bifid marginals.

Nearly allied to *Parmarion*; seems only to differ by the position of the respiratory orifice, and the want of the horn-shaped process to the caudal pore.

DENDROLIMAX, Heynem., 1868.

Distr.—Prince's Island. *D. Heynemanni*, Dohrn.

Animal limaciform, subcylindrical, blunt before, tapering behind, tentacles simple; mantle small, anterior, concealing an internal shell-plate, perforated posteriorly; longitudinal furrows above the margin of the foot? a caudal mucous pore, with overhanging, horn-shaped process; distinct locomotive disk: anal and respiratory orifices at anterior right edge of mantle; orifice of combined genital system behind and below right eye-peduncle.

Shell-plate internal, suboval, slightly convex, small, with posterior nucleus and concentric lines of growth.

Jaw smooth, with median projection.

Lingual membrane with peculiarly shaped teeth, centrals tricuspid, laterals bicuspid, marginals aculeate, bicuspid.

The horn-shaped process only seems to distinguish it from *Urocyclus*, the position of the respiratory orifice from *Parmarion*.

Dentition peculiar.

Dr. Fischer considers this genus a synonym of *Urocyclus*, Gray.

OOPELTA, Mörch, 1867.

Distr.—Java, Ceylon, Cape of Good Hope, Guinea. *O. nigropunctata*, Mörch.

Body limaciform, subcylindrical, tapering behind; tentacles simple; mantle small, oval, more pointed behind; no longitudinal furrows above the margins of the foot, and no caudal mucous pore; no distinct locomotive disk; external respiratory and anal orifices on the right slightly anterior margin of the mantle; orifice of combined generative system behind and under the right eye-peduncle.

No internal shell-plate.

Jaw smooth, with a median projection.

Lingual membrane with tricuspid centrals, bicuspid laterals, quadrate marginals.

The two following genera, together with Selenites, Fischer (*Helix concava*, Say), constitute the family Selenitidæ, Fischer, characterized by the dentition of Testacella united to the jaw of Limax. The elements thus united appear to me to be otherwise too incongruous. If such characters are sufficient for the formation of families, then Cystopelta, Tate, would require a new family also, having the teeth of Testacellidæ with the ribbed jaw of Arion; and so we might multiply families *ad infinitum*.

PLUTONIA, Stabile, 1864.

Syn.—Viquesnelia, Morelet (not Deshayes).

Dist.—*P. Atlantica*, Morelet. Azores.

Body compressed behind, carinated, rugose; mantle median, free in front, with posterior pulmonary orifice; posterior extremity subtruncated, without mucous pore; jaw without ribs or median rostriform projection; teeth like Testacella. Internal shell-plate oblong, Ancyliiform, with a rudimentary spire.

The shell of this genus was considered by Morelet and Drouet a recent representative of the genus Viquesnelia, Desh., 1857; a name given to certain fossils of the nummulitic beds of Roumelia. The identification is, however, imaginary.

TRIGONOCHLAMYS, Böttger, 1881.

Dist.—*T. imitatrix*, Böttg. Caucasus.

Animal limaciform, with two dorsal and two lateral grooves, directed from the mantle towards the head; mantle behind the middle of the body very small, attached all around, granular; anal and respiratory orifices behind the right margin of the mantle; tail short, compressed, carinated, without mucous pore; jaw similar to that of Parmacella, radula to Testacella. No internal shell?

PSEUDOMILAX, Böttger, 1881. Differs in its mantle, being free in front and on the right side; genital orifice on the right side of the neck. Jaw and radula not observed. No internal shell? *P. Lederi*, Böttger. Caucasus.

ASPIDIPORUS, Fitzinger, 1833.

Like *Limax*, with perforated mantle.

FAMILY TEBENNOPHORIDÆ.

Animal naked. Mantle covering the entire back. No mucous pore; jaw oxygnathous; lingual dentition similar to *Helix*. No shell.

TEBENNOPHORUS, Binn., 1842.

Syn.—*Incillaria*, Bens., 1842. *Megimathium*, Van Hasselt, 1824. *Philomycus*, Raf., 1820.

Distr.—Asia, North and Central America. *T. Carolinensis*, Bosc (ci, 52; iii, 44). United States.

Animal limaciform, cylindrical, blunt before, slightly attenuated behind; tentacles simple; mantle covering the whole back; no longitudinal furrows above the margin of the foot, and no caudal pore; no distinct locomotive disk; external respiratory and anal orifices near the head, somewhat to the rear of the right eye-peduncle; orifice of combined genital system behind and below the right eye-peduncle.

Shell or shell-plate none.

Jaw smooth, with median projection.

Lingual membrane long and narrow, centrals and first laterals unicuspid, outer laterals bicuspid, marginal teeth quadrate.

PALLIFERA, Morse, 1864. Jaw ribbed. *P. dorsalis*, Binney. United States.

FAMILY ARIONIDÆ.

Animal naked, with or without mucous pore; mantle concealing a shell-plate, or a few calcareous grains which represent it; jaw strongly ribbed; central tooth tricuspidate, the median cusp long and narrow, laterals and marginals bicuspidate.

ARION, Fer.

Syn.—*Prolepis* and *Lochea*, Moquin-Tandon, 1855. *Baudonia*, Mabile. *Kobeltia*, Seibert.

Distr.—Europe, Northern Asia and Africa. *A. fuscatus*, Fer. (ci, 53).

Animal limaciform, subcylindrical, attenuated behind; tentacles simple; mantle small, anterior, concealing calcareous grains, sometimes agglomerated into a shelly plate; longitudinal furrows above the margins of the foot, meeting over a caudal

mucous pore; a distinct locomotive disk; exterior respiratory and anal orifices on the anterior right margin of the mantle; orifice of the combined genital system below the last.

Internal calcareous grains, in some species agglomerated, forming an imperfect shell-plate.

Jaw ribbed. Lingual membrane with tricuspid central teeth, tricuspid or bicuspid laterals, and quadrate marginals.

The "land-soles" occasionally devour animal substances, such as dead worms or injured individuals of their own species. They lay 70-100 eggs between May and September, are 26-40 days hatching, and attain their full growth in a year; they begin to oviposit a month or two before that period. The eggs of *A. hortensis* are very phosphorescent for the first fifteen days (Bouchard).

BAUDONTIA, Mabile. Distinguished from *Arion* by being anteriorly enlarged and depressed, the shield almost smooth, the head well separated from the body, and the tentacles rather small. Characters of but little value. 2 Portuguese sp.

ARIUNCULUS, Lessona, 1881. Genital orifice nearer the tentacle than the pulmonary orifice. 3 sp. *A. Speziæ*, Lessona. Piedmont.

LOCHEA, Moquin-Tandon, 1855. Shell represented by unequal, isolated, calcareous granulations. *A. rufus*, Linn. Europe.

PROLEPIS, Moquin-Tandon, 1855. Shell rugose, produced by the aggregation of separate calcareous particles. *A. fuscus*, Müll. Europe.

ARLIMAX, Mörch, 1860.

Distr.—5 sp. Pacific coast of United States. *A. Columbianus*, Gould (ci, 54).

Animal limaciform, subcylindrical, tapering behind; tentacles simple; mantle anterior, small, concealing an internal shell-plate; longitudinal furrows above the margin of the foot, meeting over a caudal mucous pore; a distinct locomotive disk; external respiratory and anal orifices on the posterior right margin of the mantle; orifice of combined genital system on the right side of the body, below the anterior free edge of the mantle. Shell-plate internal, solid, flat, longer than wide.

Jaw ribbed. Lingual membrane with tricuspid centrals, bicuspid laterals and quadrate marginals.

Arlimax differs from *Prophysaon* by the position of the respiratory orifice in the hinder half, and of the genital orifice below the free part of the shield, and the presence of a mucous pore.

GEOMALACUS, Allman, 1843.

Distr.—Eastern Europe. *G. maculatus*, Allm. (ci, 55).

Animal limaciform, subcylindrical, blunt behind; tentacles

simple; mantle anterior, close to head, concealing a shell-plate; longitudinal furrows above the margin of the foot? a caudal mucous pore; a distinct locomotive disk; external respiratory and anal orifices on the right far anterior margin of mantle; orifice of combined genital system behind and below right eye-peduncle.

Shell-plate calcareous, flat, small, internal, ovate.

Jaw ribbed. Lingual membrane with tricuspid centrals, bicuspid laterals, quadrate marginals.

LETOURNEUXIA, Bourg., 1866. Animal limaciform, subcylindrical, scarcely attenuated behind; tentacles simple; mantle small, anterior, concealing a shell-plate; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; no distinct locomotive disk; external respiratory and anal orifices on the right anterior margin of the mantle; orifice of the combined genital system? Shell-plate internal, calcareous, suboval, flat. Jaw ribbed. Lingual membrane? There is a peculiar overhanging process to the side of the body, near the tail. Algiers. *G. Numidicus*, Bourg.

ANADENUS, Heynemann, 1863.

Distr.—2 sp. Himalaya Mountains. *A. giganteus*, Heynem.

Animal limaciform, subcylindrical, tapering behind; tentacles simple; mantle anterior, concealing an interior shell-plate; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; a distinct locomotive disk; external respiratory and anal orifices on the right posterior margin of the mantle; orifice of the combined genital system behind and below the right eye-peduncle.

Internal shell small, oval, flat, with posterior nucleus and concentric striæ.

Jaw with numerous ribs. Lingual membrane with tricuspid centrals, bicuspid laterals, and quadrate marginals.

PROPHYSAON, Bland and Binney, 1873.

Distr.—1 sp. Pacific coast of United States. *P. Hemphilli*, Binney and Bland.

Animal limaciform, subcylindrical, tapering behind; tentacles simple; mantle small, anterior, concealing a shell-plate; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; no distinct locomotive disk; external respiratory and anal orifices on the right anterior margin of the mantle; orifice of combined genital system behind and below the right peduncle.

Internal shell-plate thick, small, flat, longer than wide.

Jaw ribbed.

Lingual membrane with tricuspid centrals, bicuspid laterals and quadrate marginals.

Closely allied to *Anadenus*.

HEMPHILLIA, Bl. and Binn., 1872.

Distr.—1 sp. *H. glandulosa*, B. and B. (xcii, 74). Coast of Oregon.

Animal limaciform, blunt before, swollen at centre, and greatly attenuated behind; tentacles simple; mantle subcentral, large, oval, concealing all but a rounded large orifice; an internal shell-plate; longitudinal furrows above the margin of the foot and caudal mucous pore, over which is a hump-like process; no distinct locomotive disk; external respiratory and anal orifices at the central right margin of the mantle; orifice of combined genital system near the right eye-peduncle.

CRYPTOSTRAKON, W. G. Binn., 1879.

Distr.—*C. Gabbi*, Binney. Costa Rica.

Animal limaciform, subcylindrical, attenuated behind; tentacles simple; mantle slightly anterior, thin, small, concealing the shell; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; distinct locomotive disk? external respiratory and anal orifices on the right central margin of the mantle; orifice of genital organs?

Shell internal, sigaretiform, rudimentary, large as mantle, membranous, subspiral, with postero-lateral nucleus.

Jaw ribbed. Lingual membrane with tricuspid central teeth, bicuspid laterals, and quadrate marginals.

CYSTOPELTA, Tate, 1881.

Distr.—*C. Petterdi*, Tate. Tasmania.

Body attached for half its length to the back of the foot; mantle very large, enveloping the whole animal in repose, but from beneath which the head and the tip of the tail alone are visible from above, when the animal is crawling; tentacles four; tail with a mucous pore at the tip; mandible like that of *Arion*; lingual teeth resembling those of *Testacella*. No shell.

DAMAYANTIA, Issel, 1874.

Distr.—*D. dilecta*, Issel. Borneo.

Animal without shell; mantle forming a rounded prominence in the front half of the body; a mucous pore at the hinder end of the foot. No jaw observed.

OTHELOSOMA, Gray.

Insufficiently described, resembling more the leech of Ceylon

than a slug. No exact generic characters are given. *O. Symondii*, Gray. Gaboon, Africa.

EUMELUS, DEROCERAS, ZILOTEA, URCINELLA, TESTACINA, LIMACIAS, Rafinesque. All unrecognized genera of slugs.

PARMULA, SCUTELLIGERA = Larvæ of insects — GRAY, *Cat. Brit. Mus.*, 161.

† † *Elasmognatha*.

Jaw with a superior quadangular accessory plate.

FAMILY SUCCINEIDÆ.

Shell oblique, sometimes flattened, paucispiral, very thin, transparent.

Inferior tentacles but slightly developed or wanting; jaw with a median quadrangular accessory piece, projecting upwards (xiii, 63); central tooth tricuspid, same size as the laterals which are bi- or tricuspid, marginals narrow at base, multicuspid.

SUCCINEA, Drap., 1801.

Syn.—Cochlohydra, Fer., 1819. Neritostoma, Klein, 1753. Lucena, Oken, 1815. Amphibina and Amphibulina, Hartmann, 1821.

Distr.—200 sp., world-wide; subaquatic, living in damp places, near the margins of streams. Fossil; Eocene—

Shell oval, very fragile and transparent; spire short; the whorls few, and very rapidly enlarging; aperture oval; outer lip thin, not reflected, united below by a broad curve with the thin, smooth columella.

Animal large, usually barely retractible within its shell; tentacles short and thick, the inferior pair inconspicuous; foot broad.

TAPADA, Studer, 1830. (Succinea, restricted.) Whorls well-rounded, with impressed sutures. *S. obliqua*, Say (c, 32). U. S.

BRACHYSPIRA, Pfr., 1855. Shell ovate, inflated; spire very short, acuminate; last whorl flattened, scutiform; aperture large, angulated. *S. ovalis*, Gould. *S. putris*, Linn. (c, 33).

TRUELLA, Pease, 1871. Shell elongate, slender; aperture contracted behind. 3 sp. Polynesia. *S. procera*, Gld., etc.

PELTA, Beck, 1837. *S. Cumingii*, Beck. Ins. Juan Fernandez.

HELISIGA, Lesson, 1829. Shell ovate-ventricose; spire very short; aperture wide, patulous; peristome acute. Eye-peduncles short, cylindrical, swollen at the base; tentacles short, rudimentary. *S. Sancta-Helenæ*, Lesson. St. Helena.

OMALONYX, d'Orb., 1841.

Distr.—5 sp. West Indies and Brazil. *O. unguis*, d'Orb. (c, 36).

Animal limaciform, blunt before, short behind; tentacles simple; mantle large, central, its margins holding the edges of the external shell; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; no distinct locomotive disk; external respiratory and anal orifices on the right central margin of the mantle; generative orifice below and behind the right eye-peduncle.

Shell external, its margins embedded in the mantle, rudimentary, paucispiral, oval, depressed, unguiform.

Jaw smooth, with median and accessory quadrate plate. Lingual membrane with tricuspid centrals, tricuspid laterals, and multifid quadrate marginals.

HYALIMAX, H. and A. Ad., 1855.

Distr.—Mauritius, Nicobar Islands. *H. pellucidus*, Quoy (ci, 49, 50).

Animal limaciform, swollen at centre, blunt before, and tapering behind; tentacles simple; mantle large, central, concealing all but a small opening; an internal shell-plate; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; no distinct locomotive disk; external respiratory and anal orifices on the central right margin of the mantle; orifice of combined genital system on right side of head, half-way between eye-peduncle and mantle.

Shell large, rudimentary, thin, oval, unguiform, non-spiral.

Jaw smooth with blunt median projection and accessory quadrate plate.

Lingual membrane with tricuspid central teeth, multifid laterals, and quadrate marginals.

LITHOTIS, Blanford, 1863.

Distr.—3 sp. India, Tahiti. *L. rupicola*, Bl. (c, 40).

Shell external, auricular, ovate, thin, with an external longitudinal carina and corresponding internal sulcus; aperture rather large, continuous; spire small. The animal has large eyes, on short, retractile peduncles tumid towards the base; inferior tentacles not visible; foot short, pyriform.

Jaw oxygnathous; radula like *Helix*.

The position of this genus is uncertain; it appears to agree with the Succineidæ in the want of inferior tentacles, but differs in the character of the jaw.

CATINELLA, Pease, 1871.

Distr.—3 sp. Polynesia. *C. rubida*, Pease. *C. explanata*, Gld. (c, 34).

Shell planulate, fragile, spire rudimentary. Arboreal.

ATHORACOPHORUS, Gould.

Syn.—Janella, Gray. Aneitea, Gray. Aneiteum, McDon. Triboniophorus, Hubert.

Distr.—New Hebrides, etc. *A. bitentaculata*, Gray (ci, 51).

Animal limaciform. subcylindrical, tapering behind; inferior tentacles wanting; mantle anterior, small, triangular, lateral, adherent, enclosing the shell-plate; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; no distinct locomotive disk; external respiratory and anal orifices on the right central margin of the mantle; orifice of the combined genital system behind and below the right eye-peduncle.

Shell-plate internal, flat, calcareous, oblong, sometimes in separate grains.

Jaw smooth, with median projection and quadrate accessory plate.

Lingual membrane with peculiarly shaped teeth, with long, narrow, curving, base of attachment, and low, transverse, multifid cusp.

The animal has peculiar dorsal grooves.

CONOPHERA, Hutton. Eye-peduncles short and conical. *C. marmorea*, Hutton. New Zealand.

SUBORDER DITREMATA.

Male and female orifices widely separated; oculiferous tentacles simply contractile, not invertible.

FAMILY VERONICELLIDÆ.

Characters those of the genus *Veronicella*. The Veronicellidæ are terrestrial, the Oncidiidæ, aquatic animals.

VERONICELLA, Blain (emend.), 1817.

Syn.—Vaginula, Fer., not Vaginulus, Stoliczka.

Distr.—Asia, Africa, South and North America, in warm latitudes. *V. Floridana*, Binney (cii, 66, 67).

Animal limaciform, elongate-ovate, rounded above, flat below, margins expanded; tentacles bifid, unequal, contractile; mantle covering the whole back; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; no distinct locomotive disk; external respiratory orifice connecting with a tube to the anal orifice at the extreme posterior under part of the animal; orifice of the male genital organ at the base of the right tentacle, of the female organs at the middle of the right underside of the animal. No internal shell or plate.

Jaw with numerous ribs. Lingual membrane quite peculiar, marginals quadrate.

The Veronicellæ of South America live in families, hiding

under the trunks of trees and in fissures near the water, or on dry ground, and are never truly aquatic. They quit their retreats during the night, or during the day when it rains; remaining in a torpid state during the dry season. The species of the Old World live principally upon the trees in shady places and damp parts of the forests, concealing themselves under the leaves during the greater part of the day; they crawl quickly and leave no slimy trace behind them like the Limacidæ. Their eggs are large and oval, ten or fifteen being joined together in a necklace-like, gelatinous thread, which is coiled, and more or less covered with mucus.

FAMILY VAGINULIDÆ.

Characters those of the following genus:—

VAGINULUS, Stoliczka.

Syn.—Vaginula and Veronicella, part, of authors.

Distr.—Cochin China, etc. *V. Taunaysii*, Fer. (ci, 62).

Animal limaciform, subcylindrical, high on the back, slender and pointed at tail; tentacles bifid; mantle covering the whole back; no longitudinal furrows above the margin of the foot, and no caudal mucous pore; no distinct locomotive disk? external anal and respiratory orifice at the lower right side of the mantle about two-fifths of the length of the body distant from the front; generative orifices distinct, the female with the respiratory orifice as above described, the male orifice behind and below the right eye-peduncle.

No shell.

No jaw. Lingual membrane short; teeth aculeate.

For a notice of this agnathous genus as restricted from Veronicella, see Stoliczka, Jour. Asiatic Soc. Bengal, 2d series, vol. xlii, number clxxxi, p. 33.

LIMACELLUS, Blainv., 1817.

Distr.—*L. Elfortianus*, Blainv. (ci, 63).

Animal elongated, subcylindrical; the foot covering the whole ventral surface, and only separated from the back by a groove; back enveloped in a thick skin, forming anteriorly a sort of mantle over the pulmonary cavity, the orifice of which is at the right side; generative orifices distant, that of the male at the base of the right tentacle, oviduct at the posterior part of the right side; the two communicating by a groove. A doubtful genus.

FAMILY ONCHIDIIDÆ.

Characters those of the genus Onchidium. The mantle, as in Veronicellidæ, covers the entire back; the mouth is covered by a buccal veil. Aquatic.

Includes *Onchidium*, without, and *Peronia* (Blainv.) with ramified dorsal appendages, both of Indo-Pacific distribution; also *Onchidella* and the doubtful genus *Buchanania* (Lesson).

ONCHIDIUM, Buchanan, 1800.

Syn.—Oris, Risso ?

Distr.—Bengal, West Indies, etc. *O. typhæ*, Buch. (ci, 64).

Animal limaciform, elongate-oval; tentacles wanting; mouth with lobate appendages; mantle coriaceous, tubercular, covering the whole back; no longitudinal furrows above the margin of the foot, nor caudal mucous pore; no distinct locomotive disk; external respiratory orifice under the right posterior margin of the mantle; anal orifice separate from the last, posterior; male external generative orifice under the right eye-peduncle; female orifice at posterior of under side of body.

No shell or shelly plate.

No jaw. Lingual membrane broad; teeth different in shape from those of the terrestrial genera, arranged in very oblique rows; centrals tricuspid, side teeth all alike, bicuspid, inner cusp small, outer cusp larger, with greatly produced, oblique, squarely truncated cutting points.

This and the three following genera are marine, and are in many ways distinct from the rest of the Geophila.

In *Onchidium Celticum*, Cuv., the organ opening near the hinder end on the under side of the mantle, regarded as lungs by Cuvier, is really the renal organ, homologous to the organ of Bojanus in the bivalves; the heart is situated according to the type of the Opisthobranchia, and the respiratory function is performed by the dorsal surface of the mantle and its appendages. Consequently this species and possibly all the Onchidiidæ might well be removed from the pulmonata and placed with the marine slugs; which they further resemble in the larva possessing a ciliated velum and spiral shell.

ONCHIDELLA, Gray, 1850.

Syn.—Onchidina, Semper, 1882.

Distr.—11 sp. European Seas, Atlantic, New Zealand. *O. nigricans*, Quoy (cii, 68).

Animal ovate. The respiratory orifice is placed on the right side of the vent, and the male orifice on the right side of the tentacles; whereas in *Onchidium* both are in the median line, the former behind the vent, the latter behind the tentacles; no dorsal eyes. Jaw thin, scarcely distinct; median tooth of the radula tricuspid, laterals short, oblique, bicuspid; male organs more simple than in *Onchidium* and *Peronia*; large glands on the edges of the mantle.

Onchidella lives upon algæ, and is perfectly amphibious; ex-

isting for at least a month either under water or out of it (if the air is moist).

PERONIA, Blainv., 1824.

Syn.—Onchis, Fer., 1821. Oncus, Ag.

Distr.—Shores of tropical seas. *P. punctata*, Quoy (cii, 69).

Animal elongate-ovate; like the last genus, but with arbusculiform tufts and tubercles on mantle. Littoral.

BUCHANANIA, Lesson, 1830.

Distr.—Chili. *B. Oncidioides*, Lesson.

Like the last genus, but mantle smooth, with a large central tubercle and radiating striæ; oral appendages simple, subulate, retractile. Lingual dentition? The type is three-and-a-half inches long, yet has not been seen since Lesson described it, more than fifty years ago.

ORDER BASOMMATOPHORA.

Tentacles flattened-triangular or subcylindrical, contractile (but not invertible); eyes at their bases, sessile.

Shell usually covered by a corneous epidermis and oblong, few whorled, without operculum. Mostly aquatic or littoral.

Suborder GEHYDROPHILA, Fer. Teguments rugose; terrestrial, but usually inhabiting sea-shores.

Suborder HYGROPHILA, Fer. (Limnophila, Hartmann.) Teguments smooth. Fresh water.

Suborder THALASSOPHILA, Gray. Head a flattened disk, apparently resulting from the union of the tentacles to the skin of the head; inhabiting sea-shores and brackish water.

SUBORDER GEHYDROPHILA.

FAMILY AURICULIDÆ.

Shell spiral, covered by an epidermis, solid, usually thick; spire more or less elevated; whorls sometimes flattened; aperture elongated, contracted by columellar teeth, and often also by teeth within the lips.

Lingual membrane broad and elongated; teeth numerous, in slightly bent cross-series; central tooth equilateral, narrow, tricuspid; lateral and marginal teeth also tricuspid, rather inequilateral, diminishing in size towards the outer edge (xiii, 67). Head ending in a snout; mouth with a horny lunate upper jaw, and with two dilated buccal lobes, united above, separate below; tentacles subcylindrical, contractile; eyes sessile at the inner sides of their bases. Mantle closed, with a thickened margin; respiratory orifice posterior, on the right side. Sexes united.

Animal usually frequenting salt marshes and the vicinity of

the sea; mostly tropical in distribution, at least as to the larger species.

The inner walls of the whorls are usually absorbed, so as to form a single cavity for most of the interior (i, 14).

AURICULA, Lam., 1799.

Etym.—*Auricula*, a little ear.

Syn.—Ellobium, Bolten? 1798. Marsyas, Oken, 1815. Geovula, Swains., 1840. Auriculus, Montf., 1810.

Distr.—44 sp. East Indies, New Caledonia, South America, Philippines, Australia. *A. Midæ*, Linn. (cii, 70).

Shell oblong-oval, covered by a thin epidermis; spire short, conoidal, very rarely subelongated; last whorl large; rounded at the base; aperture longitudinal, narrow, ear-shaped; inner wall of the aperture with two or three plications; peristome thickened internally, without teeth.

A. Judæ, Linn., has truncated tentacles. The species are mostly found in brackish-water swamps, in tropical islands, and several of them are known to be blind.

SIONA, H. and A. Adams, 1858. (*Sarnia*, H. and A. Adams, 1855.) Shell oval-cylindrical; spire obtuse; whorls transversely striate; aperture linear; inner lip plicate; outer lip thickened within, sinuous behind. *A. avena*, Petit.

PYTHIOPSIS, Sandberger, 1870. Shell oval-conic, with a line of varices, sometimes on one side, sometimes on both sides; columellar wall with two plications, the posterior small, the anterior subhorizontal; base of the columella plicate and twisted; lip thickened within but not dentate. *A. ovata*, Lam. Eocene. This group connects *Auricula* with *Scarabus*.

AURICULASTRA, Martens. Aperture with thickened lip; shell small, with elevated spire. *A. subula*, Quoy.

CASSIDULA, Fer., 1819.

Syn.—*Sidula*, Gray, 1840. *Rhodostoma*, Swn., 1840.

Distr.—27 sp. Ceylon, East Indies, Philippines, Australasia, Polynesia. Fossil; *C. umbilicata*, Desh. Miocene of Touraine. *C. angulifera*, Petit (cii, 71).

Shell subperforated, cassidiform, solid; spire short, conoidal; last whorl very large, attenuated to the base, where it is usually carinated or angulated around the axis; aperture narrow, sinuous; inner lip dentately plicate; columellar plication strong; outer lip thickened within by a strong callosity with toothed edge.

Foot bifid behind; tentacles slim and pointed, with eyes slightly raised at their internal base.

Usually inhabits mangrove-swamps, and among loose stones near the sea-shore; some species are amphibious, and at high

tide may be noticed crawling on the sands in nearly two fathoms of water.

SCARABUS, Montfort, 1810.

Syn.—Pythia, Bolten ? 1798. Polyodonta, Fischer, 1807. Strigula, Perry, 1811.

Distr.—48 sp. India, East Indies, Philippines, Australasia. *S. Lesssoni*, Bl. (cii, 73). *S. trigonus*, Trosch. (cii, 74).

Shell oval, laterally compressed; spire sharp, conoidal; all the whorls with varices upon the narrow, angulated sides; umbilicus rimate; aperture exteriorly large, reflected, interiorly much contracted by laminated lips on both sides, the edges of which are toothed. Foot oval, not bifid behind. Terrestrial, living in woods near the shores, and loving darkness; only active after a rain; ovipositing on the trunks of trees.

PLECOTREMA, H. and A. Adams, 1853.

Syn.—Lirator, Beck ? 1837.

Distr.—27 sp. Red Sea, East Indies, Philippines, Australia to Sandwich Islands. *P. clausa*, Ad. (cii, 75).

Shell oval-conic or subfusiform, solid, usually spirally grooved; spire conical, sharp; aperture oblong, contracted; columellar lip with three plicæ, one of which is bifid; peristome thickened, usually varicose, bidentate or tridentate within.

ALEXIA, Leach, Gray, 1847.

Syn.—Phytia, Gray, 1821. Ovatella, Moquin-Tandon, 1847.

Distr.—21 sp. United States, West Indies, Madeira, Europe. *A. denticulata*, Mont. (cii, 76).

Shell oblong-oval, thin, spire acuminate; last whorl large, rounded at base; columella with an oblique plait; aperture contracted by teeth, and sometimes by a callosity of the outer lip.

Tentacles cylindrical, swollen near their extremities, which are pigmented; eyes at their internal base; foot elongated, obtuse, without transverse division.

MONICA, H. and A. Adams, 1855. Shell oblong-conic, spire elevated; whorls with revolving striæ; inner lip rather thick, with three dentiform plications. European. *A. Firmini*, Payr. (cii, 93).

TRALIOPSIS, Sandberger. Columellar wall biplicate, base of columella triplicate, lip denticulated within. *A. dentiens*, Desh. Fossil. Basin of Paris.

CARYCHIUM, Müller, 1774.

Syn.—Saraphia, Risso, 1826. Auricella, Jurine, 1817.

Distr.—15 sp. Europe, Africa, United States. Fossil. Jurassic.—*C. minimum*, Müll. (cii, 77, 78).

Shell minute, conical-pupiform, very thin, hyaline; whorls not numerous; aperture suboval, usually contracted by teeth, one or two on the columellar, and frequently one on the outer lip; columella plicate, or plication obsolete.

Tentacles rather large, cylindrical, obtuse; foot thick, obtuse behind.

CARYCHIOPSIS, Sandberger. Lip with two interior teeth. *C. Dohrni*, Desh. Fossil.

LAIMODONTA, Nuttall.

Distr.—10 sp. Polynesia. *L. Sandwichensis*, Soul. (cii, 88).

Shell oblong-oval, imperforate, thin, with revolving striae; spire elevated-conic; aperture oval; inner lip with three plications, the anterior smallest, outer lip sharp, with a transverse interior plication.

Distinguished from *Ophicardelus* by the internal elevated rib of the outer lip.

MARINULA, King, 1831.

Distr.—10 sp. Australia, Mediterranean, W. Coast of America. *M. pepita*, King (cii, 89).

Shell oval-oblong, imperforate, solid, smooth; spire short, sharp; aperture oval; inner lip rather thick, excavated with three plications, the posterior largest; outer lip simple, sharp.

CÆLESTELE, Benson, 1864.

Syn.—*Francesia*, Paladilhe, 1872.

Distr.—12 sp. India, Egypt, Arabia, Spain. *C. scalaris*, Benson (cii, 79).

Shell imperforate, elongate-cylindrical, aperture semioval; columellar margin with a subspiral plica above; peristome thin.

MELAMPUS, Montfort, 1810.

Syn.—*Conovulus*, Lam., 1812.

Distr.—120 sp. Universal, mostly tropical. Fossil. Miocene of Touraine. *M. luteus*, Quoy (cii, 80).

Shell oval-conoidal, or suboval, solid; spire rather short; aperture elongated, narrow; columellar lip with several denticiform plications; columella plicate; outer lip sharp, interior with revolving ridges.

Foot truncated in front, bifid or subbifid behind, divided below into two unequal portions by a transverse groove. Jaw fibrous, slight, curved, with sharp extremities. Teeth nearly horizontal, the central smaller than the laterals—which are tricuspid, marginals serriform.

M. bidentatis, Say, is one of the commonest of salt-marsh shells on the Atlantic coast of the United States.

TRALIA, Gray, 1840. Shell oval, smooth, spire moderate; aperture narrow, linear, wider in front; columellar lip with three oblique plications; outer lip sharp, sinuous posteriorly, internally callous, with one or several strong revolving ribs. Foot not transversely divided, the posterior extremity attenuated, not bifid. West Indies. *M. pusilla*, Gmel. (cii, 81). Should, perhaps, be considered a distinct genus.

PIRA, H. and A. Adams, 1853. Shell oval, smooth; spire elevated; aperture linear; columellar lip usually with three anterior plications; outer lip with numerous revolving riblets, forming tooth-like terminations. *M. anglostoma*, Desh. (cii, 82).

TIFATA, H. and A. Adams, 1853. Shell oval or elliptical; aperture narrow, contracted, curved; columella produced, with two lamellar plications; outer lip smooth or minutely dentate within, margin acute. *M. oliva*, d'Orb. (cii, 83).

SIGNIA, H. and A. Adams, 1855. Shell decussate or granular; columellar lip with transverse plaits; outer lip with a simple elevated transverse plication upon its inner face. *M. graniferus*, Mouss. (cii, 84).

PERSA, H. and A. Adams, 1853. Shell oval, with longitudinal ribs and revolving striæ; aperture rather large; outer lip sharp, smooth within; columellar lip with transverse lamellar plications. *M. costatus*, Quoy (cii, 85).

DETRACIA, Gray, 1840. Columellar wall not plicate, aperture very narrow. *M. cingulatus*, Pfeiffer. West Indies.

RHYTIPHORUS, Meek, 1873.

Distr.—*R. priscus*, Meek (cii, 87). Cretaceous; Utah.

Shell having the general aspect of Melampus, excepting that it has a series of small, oblique, short folds around the top of the somewhat shouldered whorls; while a slight curve in these little folds or costæ indicates the presence of a faint sinus in the lip near the suture; it has two folds on the columella, while the outer lip is thin, and apparently entirely smooth within.

OPHICARDELUS, Beck, 1837.

Distr.—11 sp. Australia, Polynesia. *O. Australis*, Quoy (cii, 86).

Shell oval-oblong, umbilicated, smooth; spire elevated-conic; aperture oval, elongated, angulated above; inner lip reflected, with two spiral plications, one of which surrounds the umbilicus; outer lip thin, simple.

AUTENOË, Guppy.

Distr.—*A. riparia*, Guppy. Trinidad.

Closely resembling Melampus and Laimodonta, differing chiefly from the former in its thin and horny shell, and from the latter in its short spire and longer aperture.

LEUCONIA, Gray, 1840.

Distr.—7 sp. Europe, United States, West Indies, Loo Choo Islands. Fossil. Miocene of Europe. *L. Sayi*, Küster (cii, 90).

Shell oval-oblong, thin, nearly smooth, imperforate; spire conic; aperture oval-elongated; columellar wall with one or two plaits; columella with a distinct basal plait, oblique; peristome simple, without teeth.

The *Leuconias* live in situations often covered by the tides. The animal has a foot truncated in front, obtuse behind, and transversely divided on the sole. The shell closely resembles *Alexia*.

BLAUNERIA, Shuttleworth, 1854.

Distr.—3 sp. New Caledonia, Sandwich Islands, Europe, West Indies and United States. *B. pellucida*, Pfr. (cii, 91).

Shell sinistral, imperforate, oblong-turreted, thin; aperture narrow, elongated; inner lip with a single plait, columella sub-truncate; outer lip simple.

STOLIDOMA, Deshayes, 1864. (Macrodonta, Desh.) Shell oblong, turriculated, subcylindrical; apex obtuse, smooth, polished; aperture elongated, obliquely inflected, narrowed behind, widened in front; columella straight, with a large median plait, compressed, and slightly oblique. 3 sp. Eocene; Paris Basin. *B. crassidens*, Desh. (cii, 72).

The shells of this genus are Auriculæ, with a single columellar plait, without teeth or plications on the right lip.

PEDIPES, Adanson, 1757.

Distr.—11 sp. Red Sea, Mauritius, W. Africa, New Caledonia, Panama, Lower California. Fossil. Eocene; Paris Basin. *P. afer*, Gmel. (cii, 92).

Shell imperforate, oval-subglobose, solid, spirally striate, whorls few, the last very large; aperture much contracted by teeth; columellar lip with usually three dentiform plications, of which the posterior one is largest and spiral; outer lip sharp, callous or dentate within.

Foot divided inferiorly by a transverse groove. When the *Pedipes* walks, the hinder part of the foot is fixed, and the fore-part, which is separated from the hind-part by an extensible groove, is advanced, and the hind-half is then drawn forwards so as to touch the anterior half, and so progression is effected by a series of little steps. This movement, similar to that of the geometric or looping caterpillars, is executed with such quickness that few mollusks, according to Adanson, excel the *Pedipes* in alertness. The animal lives in tropical countries, in cavities of rocks, more especially of those exposed to the sea.

FAMILY OTINIDÆ.

Shell external, paucispiral, auriform or pileiform; aperture large, oval; peristome simple.

Jaw with a superior quadrangular projection as in *Succinea*; radula with simple, narrow, unicuspid laterals, and bicuspid marginals.

These mollusks unite with an animal resembling *Auricula*, the shells of an *Ancylus* or *Lamellaria*.

Differs from *Auriculidæ* in having flattened tentacles, and from *Limnæidæ* in having the eyes on the upper part of the base of the tentacles, instead of at the inner edge of the base, and in having colored shells. Amphibious.

OTINA, Gray, 1847.

Distr.—Europe. *O. otis*, Turton (ciii, 2).

Shell thin, globular-sigaretiform, paucispiral; whorls rapidly enlarging; aperture very large, oval; columellar lip smooth; outer lip simple, sharp.

Tentacles nearly obsolete; eyes sessile, on the upper part of the head at their hind bases. Foot divided by a transverse groove across its centre, and furnished with a creeping disk at each end.

These animals, whose shells so closely resemble those of *Velutina*, inhabit chinks of rocks between tide-marks. They progress in the same manner as *Pedipes*, by alternately fixing and moving forwards the anterior locomotive disk.

CAMPTONYX, Benson, 1858.

Distr.—*C. Theobaldi*, Benson (ciii, 4). India.

Shell cap-shaped, obliquely conical, with a subspiral free apex directed to the right side; surface with an external longitudinal ridge, and corresponding internal furrow extending from the apex to the right margin; aperture large, ovate, entire, expanded at the margin. The shell is like a *Pileopsis*, with a respiratory channel on the right side.

“Animal with the respiratory orifice on the edge of the mantle. Eyes sessile at the middle of the hinder part of the base of the tentacles, and are visible only from above; tentacles rather conical than angular; upper mandible conspicuous, slightly lobed; lingual ribbon broad, with 86 rows of teeth, 87 in a row (43.1.43); they have simple obtuse hooks as in *Ancylus*; the central row only differs in being symmetrical; the laterals diminish gradually from the 14th to the 43d, and a second cusp makes its appearance, and increases until the three near the margin are regularly bicuspid.”—WOODWARD.

The habits of *C. Theobaldi* are terrestrial, although it lives attached to rocks, like *Patella*.

VALENCIENNESIA, Rousseau, 1842.

Dedicated to the late Professor Valenciennes of Paris.

Distr.—*V. annulata*, Rousseau. Associated with fresh-water shells in a tertiary deposit near Kertch, Crimea.

Shell resembles a gigantic *Ancylus*; apex much incurved; surface concentrically marked. A longitudinal plication extends from the apex to the right side of the posterior border, and corresponds with an internal channel; there is a second but less distinct plication on the left side.

SUBORDER *HYGROPHILA*.

Teguments smooth; living in fresh water and only coming to the surface occasionally to renew their supply of air. Tentacles contractile, with eyes at their base. Jaw simple in *Physa*, and compound in *Limnæa* and *Planorbis*, composed of three pieces corresponding to the three lips of the mouth, and not completely separated. Central and lateral teeth as in *Helicidæ*, marginals pectinate or serriform.

Male orifice near the tentacle, female at the base of the neck, near the respiratory opening. Eggs contained together in a gelatinous, transparent capsule. Embryos without velum, and undergoing but slight changes. Phytophagous (*Physa* is sometimes carnivorous). Swimming in a reversed position at the surface of the water.

FAMILY LIMNÆIDÆ.

Shell thin, horn-colored, mostly spiral, sometimes patelliform, capable of containing the entire animal contracted; aperture simple, rounded; lip sharp.

Lingual membrane armed with numerous quadrate teeth, arranged in transverse rows, the central minute, the laterals uncinated, the marginals multicuspidate (xiii, 64, 65). Head with a broad, short muzzle dilated at the end; mouth with a horny upper jaw, composed of three pieces, the central much the largest (xiii, 66; tentacles flattened or filiform, with the eyes sessile at their inner bases. Mantle-margin variously modified, respiratory orifice at the right side. Foot flattened, lanceolate or ovate.

The fresh-water, air-breathing mollusks of which this family is composed inhabit the rivers, ponds, and running streams in all parts of the globe, being, however, most numerous represented in temperate regions. They feed on *Confervæ* and other aquatic plants. Although usually to be seen crawling on the muddy bottoms and on the stems and foliage of submerged vegetation, they come to the surface to respire the free air, and sometimes may be observed gliding, shell downwards, on the

surface of the water, anchoring or letting themselves down occasionally by means of a glutinous thread. As is frequently the case in fluviatile shells, the apex of the spire is usually eroded. A. Pauly has studied the respiration of the Limnæidæ, and from numerous observations and experiments, comes to the following conclusions: The Limnæidæ, under natural conditions, come to the surface of the water in order to breathe air at intervals varying from a few minutes to several hours, chiefly according to the facility of reaching the surface by creeping. Under water the pulmonary orifice is kept closed, and is not extended by water; only very young snails have it open and filled with water, and this only before they begin to breathe air. If bubbles of air are present, as in shallow ponds containing many water-plants, or in an aquarium, the Limnæidæ make use of these bubbles for their respiration. Adult specimens kept from air can survive for ninety days, but they respire only by the skin, and never use the pulmonary sac as a water-respiring organ. But as the young snails, in the egg and some time after being hatched, receive water in their pulmonary orifice, it is possible that those which live at a considerable depth may retain this sort of respiration during their whole life, together with respiration by the skin. S. Clessin thinks that the Limnæidæ normally respire water, and that they are compelled to come to the surface and respire air only by unusually high temperature. (Mal. Bl., xxiv, pp. 175, 176.)

The following arrangement of the genera of the family is mainly that proposed by Mr. Wm. H. Dall.

SUBFAMILY LIMNÆINÆ.

Shell spiral, the spire more or less elongated.

LIMNÆA, Lam., 1798.

Etym.—*Limnaïos*, marshy. Pond-snail.

Distr.—200 sp. Europe, Asia, America, north of the Equator, Polynesia. Fossil, 75 sp. Wealden—, Europe; Laramie—, N. America.

Shell normally dextral, oval-oblong, thin, corneous, translucent; spire sharp, more or less acuminate; last whorl ventricose; aperture oval, ample, rounded in front; columellar lip with an oblique plait entering above.

When the ponds are dried up in seasons of drought, these animals bury themselves in the mud, strengthen the outer lip of their shells by an internal rib, and close the aperture by means of an epiphragm like hibernating Helices. Their mode of propagation is very singular—three or more individuals being united in a chain for that purpose. Leach has remarked that, in consequence of the sexual parts being distant from each other, one

individual is able, at the same time, to perform the function of each sex with two others.

Bulimnæa megasoma, Say (ciii, 5), is partially carnivorous (Wetherby . Mr. Whitfield has recorded some singular changes produced in successive generations, the progeny of a single individual, confined in an aquarium. They gradually diminished in size and the male organs disappeared. Prof. Hyatt has ascribed these changes to different conditions of temperature, but it was probably due also to deficient food-supply, and an effect of the physiological law to which Mr. Meehan has so frequently called attention in plants, namely, of the greater persistence, in cases of depauperization, of female functions and members.

LYMNUS, Montf. Typical. (Auricula, Klein.) *L. stagnalis*, Linn. (ciii, 9).

RADIX, Montf., 1810. (Neristoma, Klein [teste Adams]. *Gulnaria*, Leach [teste Turton].) Shell suboval-globular; last whorl ventricose; aperture very large; columella plaited. *L. auricularia*, Linn. (ciii, 6).

POLYRHYTIS, Meek. Much like the last in form, but bearing distinct, regular, vertical costæ. *L. Kingi*, Meek. Tertiary; Utah.

BULIMNÆA, Haldeman, 1841. Shell oval, subglobular, large, the spire short, apex sharp; aperture moderate. *L. megasoma*, Say (ciii, 5).

LIMNOPHYSA, Fitzinger, 1833. Shell oval-oblong, spire elevated; aperture narrowly ovate, about half the length of the shell. *L. reflexa*, Say (ciii, 7).

LEPTOLIMNÆA, Swainson. (Omphiscola, Raf.) Shell nearly cylindrical; spire thick, lengthened; aperture small. *L. glabra*, Müll.

ACELLA Hald., 1841. Shell elongated, very slender; whorls 4-6, very oblique, but slightly convex; aperture small, ovate, expanded below. *L. gracilis*, Jay (ciii, 8).

PLEUROLIMNÆA, Meek. Shell differing from the last in having small, regular surface-costæ parallel to the lines of growth, and aperture narrowed or subangular, instead of rounded anteriorly. *L. tenuicostata*, Meek and Hayden. Fossil. Eocene; Dakotah. ? = *Acella*.

VELUTINOPSIS, Sandberger. Oval, neritiform, spire excavated, last whorl very large, columellar lip depressed. *L. velutina*. Desh. Tertiary; Crimea.

Some of the species of *Limnæa* inhabiting the Sandwich Islands and New Zealand are sinistral. *Limnæa* adapts itself to very diverse conditions; it is found in Greenland and Iceland, in hot and sulphurous springs, in fresh or brackish water. *L. Hookeri* occurs in Thibet, at an elevation of nearly 14,000 feet; *L. abyssicola* in the Lake of Geneva, at a depth of 800 feet.

AMPHIPEPLEA, Nilsson, 1822.

Syn.—Myxas, Leach, teste Turton, 1831.

Distr.—18 sp. Europe, East Indies, Australia, Philippines.
A. glutinosa, Müll. (ciii, 10).

Shell globular, ventricose, thin, transparent; spire very short, depressed; aperture very large; columella without fold; outer lip sharp.

Animal with the mantle-margins developed, partly covering the shell; tentacles flat, triangular.

ERINNA, H. and A. Ad., 1858.

Distr.—Sandwich Islands, Isle of Bourbon. *E. Newcombi*, H. and A. Ad. (ciii, 11).

Shell semiglobose, thin, horny, olivaceous, longitudinally finely striated; spire very short, obtuse, apex rather eroded, last whorl ventricose; aperture large, semioval; inner lip posteriorly ascending on the body-whorl; columella straight, excavated, and with a curved, elevated, external ridge continued in front into the outer lip, which is simple and acute.

The shell much resembles *Lithotis*, Blanford, but the descriptions of the animals differ.

LANTZIA, Jousseaume, 1872.

Distr.—*L. carinata*, Jous. Isle of Bourbon. Living in moss, at 1200 metres altitude.

Shell auriform, with very short spire, last whorl tricarinate; peristome thickened within; columellar lip flattened, forming a septum. Foot large; tentacles flattened, triangular, with eyes on prominences at their base, interiorly; jaw fibrous, of three segments.

? CANEFRIA, Issel, 1874.

Distr.—*C. splendens*, Issel. Borneo.

Shell small, cylindrically conical, summit truncated by erosion, suture lacerated, irregular, aperture entire, without plications or teeth, lip simple.

Appears to partake somewhat of the characters of *Auricula*.

PHYSA, Draparnaud, 1801.

Etym.—*Physa*, a pouch.

Syn.—*Rivicola*, Fitz., 1833. *Isidora*, Hald.

Distr.—100 sp. North America, Europe, East Indies. Fossil, 43 sp. Wealden—, Europe; Cretaceous—, N. Am. *P. ancillaria*, Say (ciii, 12). *P. fontinalis*, Linn. (ciii, 13).

Shell ovate, sinistrally spiral, thin, polished; aperture rounded in front.

Animal with long, slender tentacles; the eyes at their bases; mantle-margin expanded and fringed with long filaments. Jaw

in one piece, arcuated, finely striated with a superior, central fibrous projection, recalling the accessory plate in Succinea. Radula composed of oblique teeth, the central multicuspid, the laterals and marginals serrated and furnished with a small, narrow, special appendage at their superior, outer margin.

PHYSELLA, Hald., 1842. Shell very small, globular, with short and small spire; aperture oval, ample; columella with a well-marked plication. *P. globosa*, Hald. (ciii, 15).

PHYSODON, Hald., 1842. Shell oval-elliptic, rather solid; columella toothed. *P. microstoma*, Hald. (ciii, 16).

COSTATELLA, Dall. Shell longitudinally, laminately costate. *Ph. costata*, Newc. (ciii, 17).

APLEXA, Fleming, 1828. 2/

Syn.—Nauta, Leach, 1831.

Distr.—25 sp. Europe, North America, Northern Asia. Fossil. Eocene of Europe and United States. *A. hypnorum*, L. (ciii, 19).

Shell sinistral, thin, elongated, polished; spire conical, acuminate, with scarcely indented sutures; aperture narrowly elongate-oval; columella simple; outer lip sharp. Animal with plain mantle-margins.

MACROPHYSA, Meek, MSS. Spire enormously elongated, body-whorl and aperture small. *B. columnaris*, Desh. (ciii, 20.) Paris Basin.

BULINUS, Adanson, 1757.

Syn.—Isidora, Ehrenberg, 1831. Diastrophia, Gray, 1840.

Distr.—Mediterranean region, W. Indies, Oceanica.

Shell like Physa, oval, with very convex whorls and deep sutures, apex obtuse; an umbilical slit; columella twisted; peristome simple.

Animal resembling Aplexa; jaw in three plates; radula with bicuspid central, tricuspid laterals, serrated marginals.

PHYSOPSIS, Krauss, 1848.

Distr.—Africa. *P. Africana*, Krauss (ciii, 21).

Shell like Physa, but columella truncate below.

PLATYPHYSA, Fischer, 1883. Last whorl enlarged at the shoulder; columella truncate below. *P. Prinsepi*, Sowerby. Eocene; India.

PYRGOPHYSA, Crosse, 1879. Spire turreted. Africa, Madagascar. Probably passes into Isidora, Ehrenb. *P. Wahlbergi*, Krauss. Africa.

AMERIA, H. Adams, 1861. (Glyptophysa, Crosse, 1870.) Shell spirally sculptured, the body-whorl sometimes smooth, not glossy. 2 sp. New Caledonia, Australia. *P. lirata*, Trist. (ciii, 18).

PLESIOPHYSA, Fischer, 1883. Shell rather short. Central tooth of the radula 5-cuspidate, the median cusp the longest. *P. striata*, d'Orb. W. Indies.

PECHAUDIA, Bourg., 1882. Shell like Physopsis, but dextral, oval, transparent; columellar axis with a white lamella, strongly truncate at the base. *P. Letourneuxi*, Bourguignat. Algiers.

CAMPTOCERAS, Benson, 1842.

Distr.—3 sp. Swamps, in India. *C. terebra*, Benson (c, 35). 1 fossil species. Eocene; Sheerness-on-Sea, England.

Shell sinistral, imperforate; whorls three or four, separate, flat, carinated above and below; suture widely and profoundly excavated; aperture large, elongate-elliptical; peristome thin, continuous.

Animal has two obtuse, filiform tentacles, with large eyes placed between them; mantle not larger than the lips of the shell; foot short.

The description of the animal corresponds nearly with the Limnophila, and the sinistral shell has caused authors to place it in Physadæ.

CHILINA, Gray, 1831.

Syn.—Dombeya, d'Orb, 1837. Potamophila, Sw., 1840.

Distr.—18 sp. South America. Fossil, 1 sp. Miocene; S. Am. *C. puelcha*, d'Orb. (ciii, 22). It replaces the Limnæa of North America; lives in clear running streams.

Shell dextral, oval, rather thin, usually ornamented with dark spots or wavy bands; columella thickened, with one or two strong, prominent folds, peristome simple. Tentacles large, flattened, with sessile eyes at their superior face; pulmonary pouch with a well-developed protecting lobe; foot large, dilated in front, attenuated behind; genital orifices on the right side. No jaw? Central tooth small, 5-cuspidate, laterals and marginals multicuspidate, with a superior, external prolongation.

PSEUDOCHILINA, Dall, 1870. Shell thin, covered with a rough fibrous epidermis; spire elevated, acute. *C. Limnæiformis*, Dall. Chili.

PITHARELLA, Edwards, 1860.

Distr.—*P. Rickmani*, Ed. "Woolwich and Reading Series," Peckham and Dulwich, London.

Shell partaking of the characters of Limnæa and Chilina, sub-cylindrical; aperture oval, rounded in front, narrowed behind; columella straight, or very obliquely twisted, arched anteriorly; outer lip simple, acute; inner lip thickened.

The species is associated with estuarine shells, remains of mammals and terrestrial plants.

SUBFAMILY *POMPHOLIGINÆ*.

Shell depressed globular, spiral, the spire but slightly raised.

POMPHOLYX, Lea, 1856.

Distr.—California. *P. effusa*, Lea (ciii, 23).

Shell dextral, rotund-gibbous, reflexed beneath, flattened above, not umbilicated; spire convexly depressed; aperture very large, subcircular, expanded; outer lip acute, inner lip thickened and slightly flattened.

Buccal plate subcordiform; lateral jaws absent; genitalia on the left side (in Limnæa on the right); tentacles stout, cylindrical, slightly globose at the tips; eyes sessile on the front of the head near the inner bases of the tentacles.

In some individuals there is an aggregation of pigment-cells near the tips of the tentacles, which has been taken for a second pair of eyes, but it is nearly or entirely absent in others.

Like the next genus, the shell is dextral whilst the animal is sinistral.

CHOANOMPHALUS, Gerstfeldt, 1859.

Etym—Choanos, a funnel; omphalos, an umbilicus.

Distr.—*C. Maacki*, Gerst. (ciii, 24). Lake Baikal.

Shell dextral, nearly planorbiform, the spire being scarcely raised, widely umbilicated; aperture small, rounded, the extremities of the simple peristome united by a thin parietal callus.

Animal resembling Planorbis in its tentacles, jaw and dentition; genital, respiratory and anal orifices on the left side.

PÆCILOSPIRA, Mörch. Proposed for *Planorbis multiformis*, Zieten, a miocene fossil of Steinheim, remarkable for polymorphism, and presenting all stages of form between discoidal and conical, the last whorl in contact or reflected.

CARINIFEX, Binney, 1865.

Syn.—Megasytrophæ, Lea.

Distr.—*C. Newberryi*, Lea (ciii, 25). California.

Shell dextral, spiral, inflated, angular, horn-colored; spire elevated, terraced; last whorl very large, broad above, very rapidly attenuated below; umbilicus funnel-shaped; aperture triangular, broad above, narrow below; inner lip slightly thickened; outer lip thin, acute, angular above, flexuose.

VORTICIFEX, Meek, 1870. Shell thicker, with a smaller umbilicus, with strongly marked growth-ribs, and without revolving carinæ (except when young). *C. Binneyi*, Meek (ciii, 26). Tertiary; Nevada.

SUBFAMILY *PLANORBINÆ*.

Shell spiral, the volutions in the same plane, so that the spire

and umbilicus are both depressed. Tentacles slender, filiform; foot short; locomotion very slow.

PLANORBIS, Guettard, 1756.

Syn.—Coretus, Adanson, 1757. Orbis, Schröt. Spirodiscus, Stein.

Distr.—150 sp. World-wide. Fossil, 70 sp. Lias—.

Shell discoidal, biconcave, the whorls visible on both sides; aperture small, rounded; margin usually simple, sometimes expanded.

Animal with a short, round foot; head short, with sessile eyes at the inner bases of the slender tentacles. Lingual teeth subquadrate, central bicuspid, laterals tricuspid, marginals serrated. *P. contortus*, a minute European species, has above 6000 teeth.

The plan of the spiral in this genus is such as to yield readily to pressure; hence monstrosities are rather frequent. They consist of a tilting up of the whorls on one side or even a conical elevation of the spire. The smaller species, in America and Europe, appear to be most liable to these distortions—*P. contortus* particularly so.

Type, *P. corneus*, Linn. (ciii, 27). Europe.

TAPHIUS, H. and A. Adams, 1855. Shell strongly excavated around the umbilicus, whorls irregularly rounded; aperture oval, expanded; columellar lip straight, oblique. *P. Andicolus*, d'Orb. (ciii, 28). So. America.

HELISOMA, Swains., 1840. Shell ventricose, paucispiral, frequently carinated around the spire; each whorl nearly enveloping its predecessor. *P. bicarinatus*, Say (ciii, 29). United States.

PLANORBELLA, Hald., 1842. Shell paucispiral; aperture oblong, somewhat irregular, the whorl swollen behind it. *P. campanulatus*, Say (ciii, 30). United States.

ADULA, H. Adams, 1837. Shell with the whorls rounded and numerous, deeply umbilicated on the upper, and convex on the lower side; aperture campanulate. *Pl. multivolvis*, Case. Northern Michigan.

MENETUS, H. and A. Adams, 1855. Shell depressed; whorls rapidly enlarging, usually angulated; aperture very oblique. *M. heloicus*, d'Orb. (ciii, 31). So. America.

GYRAULUS, Agass., 1837. (Nautilina, Stein, H. and A. Adams, 1855. Girorbis, Agass., 1837.) Shell discoidal, whorls few, rapidly enlarging, periphery sometimes carinated; last whorl sometimes deflected. *P. deflectus*, Say.

BATHYOMPHALUS, Agass., 1837. (Spirorbis, Swains., 1840.) Shell depressed; whorls numerous, rounded, not carinated. *P. anatinus*, d'Orb. (ciii, 32). So. America.

ANISUS, Studer, 1820. (Trophidiscus, Stein.) Shell much

depressed, whorls numerous, carinated; aperture oblique. *A. kermatoïdes*, d'Orb. (ciii, 33).

DREPANOTREMA, Crosse and Fischer. Whorls subglobose, the last enveloping, aperture narrowly lunate. Central America. *P. Ysabalensis*.

SEGMENTINA, Fleming, 1830.

Syn.—Discus, Hald., 1840. Segmentaria, Swains., 1840.

Distr.—Europe, Asia, Australia. *S. lacustris*, Lightf. (ciii, 34). Europe.

Shell flattened; whorls usually laterally compressed, with angulated periphery, the last whorl embracing, internally contracted by periodic lamellæ, usually three in number, and occurring three times in each volution.

PLANORBULA, Hald., 1840. Shell discoidal, with rounded whorls, divided interiorly at intervals by septa consisting of five lamelliform teeth. *S. armigera*, Say (ciii, 35, 36). United States.

SUBFAMILY ANCYLINÆ.

Shell non-spiral, patelliform or conical.

ANCYLUS, Geoffroy, 1767.

Etym.—*Ancylus*, a small round shield. River limpet.

Syn.—Angulus, Mühlfeldt.

Distr.—50 sp. North and South America, Europe, Australia. Fossil, 8 sp. Eocene, Europe; Laramie —, United States. *A. concentricus*, d'Orb. (ciii, 37).

Shell conical, limpet-shaped, thin; apex posterior, turned to the left; aperture with entire, basal margin; interior with a sub-spiral muscular scar.

Animal with large oval foot; tentacles triangular, with eyes at their internal bases; jaw thin; central tooth very small, laterals bicuspidate, marginals saw-like.

ANCYLASTRUM, Moquin-Tandon, 1853. Genital and pulmonary orifices on the left side. Apex of the shell inclining to the right. *A. fluviatilis*, Müller.

ACROLOXUS, Beck, 1837. (Velletia, Gray, 1840.) Apex sinistral; shell narrow, oblong. Animal with genital and pulmonary openings on the right side. *A. lacustris*, Linn. (ciii, 38). 3 sp. Europe, West Indies, United States.

CUMINGIA, Clessin. Shell conical, top coiled, aperture oval. *A. Cumingianus*, Clessin.

HALDEMANIA, Clessin. Shell conical, top slightly excentric, but not bent backwards, aperture rounded or oval. *A. obscurus*, Hald. United States.

LANX, Clessin. Shell large, patelliform, elevated at the extremities, thin, with concentric striæ; apex very obtuse, rounded; aperture ovate, the margin acute. *A. Newberryi*, Lea.

BRONDELIA, Bourg., 1860. Apex more minute than in the type, sinistral, with a persistent spiral nucleus. Terrestrial, living on humid rocks in the forest of Edough, Boue (Algeria).

LATIA, Gray, 1849.

Distr.—2 sp. New Zealand. Fossil, 1 sp. Eocene; Idaho. *L. neritoides*, Gray (ciii, 39).

Shell ancyloid, with subspiral summit; the interior is provided posteriorly with a semicircular transverse ledge or plate, attached to the shell on the left, turned up and notched on the right side.

Animal with elongated foot, well distinguished from the mantle; eyes external to the tentacles; no jaw? Central tooth bicuspid, laterals unicuspid, marginals tricuspid.

GUNDLACHIA, Pfeiffer, 1849.

Dedicated to Dr. Gundlach, a distinguished Cuban conchologist.

Syn.—Poeyia, Bourg., 1860.

Distr.—5 sp. United States, Cuba, Tasmania. Fossil. Basin of Mayence. Pliocene; W. Indies. *G. ancyliformis*, Pfr. (ciii, 40).

Shell very small, thin, obliquely conic, apex inclined posteriorly and to the right; base two-thirds closed by a flat, straight-edged shelf, leaving a semicircular aperture.

Radula; central tooth bicuspid, laterals and marginals multicuspid.

Poeyia was described from a young Gundlachia without septum; on the other hand the young of *Ancylus textilis*, Guppy, of Trinidad, are sometimes provided with a septum, sometimes without it; so that the presence or absence of the septum is not always a sure means of distinguishing the genera.

ACROCHASMA, Reuss, 1860.

Distr.—*A. tricarinatum*, Reuss (cii, 94), from the fresh-water limestones (Miocene) of Bohemia.

Shell trilateral, pyramidal, rounded below in its whole amplitude, with one posterior concave, and two lateral slightly convex planes, ending upwards in an acute reflected apex, beneath with a longitudinal aperture through the shell, which in its living state appears to have been covered with an epidermis. It may be considered as a fresh-water representative of the marine genus *Puncturella*.

This, and the genus *Valenciennesia*, previously described, may belong to the family Siphonariidæ.

SUBORDER THALASSOPHILA.

Head a dilated disk without distinct tentacles, the eyes sessile on its upper surface; pulmonary pouch protected by a valvular

appendage of the mantle, with, in Siphonaria, a branchia in addition.

Three families are admitted.

Spiral, operculate. Amphibolidæ.

Conical (limpet-like), not operculate. Siphonariidæ, Gadiniidæ.

FAMILY AMPHIBOLIDÆ.

Shell spiral, subglobose, operculated.

Animal with the external features and dentition of the pulmonata, but the respiratory cavity only communicates with the free air by a small valvular opening. Aquatic, living in brackish water.

They partake of the characters both of the aquatic pulmonata and of the Ampullariidæ, and might be considered as related to that family perhaps quite as much as to the former.

AMPHIBOLA, Schumacher, 1817.

Syn.—Ampullacera, Quoy, 1832. Thallocera, Swains., 1840.

Distr.—New Zealand. *A. nux-avellana*, Chemn. (ciii, 41).

Shell subglobose, rather thick, rugose, umbilicated; spire short, whorls shouldered above; umbilicated; aperture suboval; columellar lip callous; columella flattened and reflected; outer lip sinuous posteriorly; operculum corneous, subspiral.

Lingual membrane large, very broad, expanded, and long, with a central space or line scarcely defined; teeth numerous, equal, similar, four-sided, rather longer than broad, in straight cross-lines, with a broad rounded lobe, rather more sinuous on the inner than on the outer side of its front edge. Eyes sessile on the front part of the cephalic disk formed by the expanded tentacles. Respiratory cavity closed, except a small valvular opening on the right side.

The animals of this family inhabit salt marshes near the sea, the living shells sometimes having Serpulæ attached to them. They appear to respire the free air. The Amphibolidæ offer an exception to the general rule, that pulmonifers with a closed mantle-cavity are destitute of opercula. They live in pools of brackish water, and at certain seasons bury themselves in the sandy mud. The New Zealanders collect and employ them as articles of food.

AMPULLARINA, Sowb., 1842. Shell thin, globular, umbilicated; spire short; whorls rounded; inner lip simple; outer lip sinuous in the middle. *A. fragilis*, Quoy (ciii, 42).

FAMILY SIPHONARIIDÆ.

Characters those of the typical genus.

SIPHONARIA, Sowerby.

Distr.—90 sp. Cape, India, Philippines, Australia, New Zea-

land, Pacific, Galapagos, Peru, Cape Horn, West Indies, W. Coast of N. America. Fossil, 3 sp. Miocene—; France. Type, *S. siphon*, Sowerby (cii, 97).

Shell somewhat like *Patella*; apex subcentral, posterior; muscular impression horseshoe-shaped, divided on the right side by a deep siphonal groove, which produces a slight projection on the margin.

Animal with a broad head, bilobed but not tentaculate; eyes sessile on prominent rounded lobes; pulmonary chamber covered by a lobe of the mantle; the rudimentary branchiæ form triangular folds of the lining membrane of the mantle, connected by a raphe. The Siphonariæ are found between tide-marks, like limpets.

SIPHONARIA (restricted), Dall. Shell solid, porcellaneous; apex central or subcentral; provided with more or less elevated radiating ribs or ridges, which by their projection render the margin irregular. *S. gigas*, Sowb.

LIRIOLA, Dall, 1870. Shell thin, horny; smooth, or furnished with fine radiating lines, which do not interrupt the margin; apex marginal or submarginal, twisted to the left of the median line in most of the species. *S. thersites*, Carp.

ANISOMYON, Meek, 1860. (Allerya, Mörch. Scutulum, Monts) Shell thin, fragile, with subcentral apex, spiral in young individuals, and obliterated siphonal fold. Jaw thin, flexible, striated. *S. patelliformis*, Meek and Hayden (cii, 95). The type is a cretaceous fossil, but several recent shells also belong here.

? HERCYNELLA, Kayser. Shell large, rounded in outline, unsymmetrical, the summit drawn to one side; surface finely radiately or concentrically striated, with a strong fold proceeding from the apex to the border, and a corresponding depression within the shell. *H. Beyrichi*, Kayser. U. Silurian.

FAMILY GADINIIDÆ.

Characters those of the typical genus.

GADINIA, Gray, 1824.

Syn.—Mouretia, Sowb., 1834. Rowellia, Cooper, 1865.

Distr.—10 sp. Mediterranean, Red Sea, Africa, Peru, W. Coast of N. Am. *G. afra*, Gray (cii, 96). Fossil, 1 sp. Sicily.

Shell obliquely conical; muscular impression horseshoe-shaped, the right side shortest, terminating at the siphonal groove.

Animal pulmoniferous, without gills; rostrum bifid.

CLASS SCAPHOPODA.

Shell a hollow cylinder, open at both ends. Head rudimentary; foot vermiform, lobulate; nervous system simplified, resembling that of the lamellibranchs.

The shells of the Scaphopoda are immediately distinguishable from those of all other living mollusks by external form, being straight or slightly curved tubes, without spire.

FAMILY DENTALIIDÆ.

Shell tubular, symmetrical, curved, open at each end, attenuated posteriorly; surface smooth or longitudinally striated; aperture circular, not constricted.

Animal attached to its shell near the posterior anal orifice; head rudimentary, eyes 0, tentacles 0; oral surface fringed; foot pointed, conical, with symmetrical side-lobes, and an attenuated base, in which is a hollow communicating with the stomach. Branchiæ 2, symmetrical, posterior to the heart; sexes separated.

The tooth-shells are animal-feeders, devouring foraminifera and minute bivalves; they are found in sand, or mud, in which they usually bury themselves.

Sars divides the Scaphopoda into two orders: I think that his distinctive characters are barely sufficient to be used in a subfamily sense.

SUBFAMILY DENTALIINÆ.

Posterior aperture of the shell entire or with a ventral slit, provided with a supplementary tube. Foot trilobate. Edge of the lateral plates of the radula indistinctly dentate. (Order Scaphopoda, Sars.)

DENTALIUM, Linn., 1758.

Distr.—75 sp. Universal. *D. elephantinum*, Linn. (ciii, 98).

Animal with a short foot, anteriorly thickened and tripartite. Shell tube-like, gradually tapering posteriorly, longitudinally ribbed, margin of the aperture sharpened, posterior end with an internal, slightly projecting tube, which is provided with a dorso-ventrally elongated opening, the outer layer having a very slight emargination dorsally and ventrally.

“The Dentalium burrows in the sand by means of its conical foot, in a slanting direction; the narrow end is, of course, uppermost, and is kept in communication with the air or water for the purpose of respiration. It feeds on foraminifera and other

minute organisms, which it catches with its thread-like tentacles. These are all lengths and sizes, and are insinuated among the grains of sand on every side; they are covered with cilia, especially at the points, which resemble suckers. They are thrown off by the Dentalium under certain conditions, and may occasionally be seen detached and wriggling like taper hair-worms. *Terebella* and other tubular annelids have similar organs. Being highly contractile, these tentacles convey the food to the funnel-shaped mouth, in which, by the aid of the labial and ciliated palps, the animalculæ are quickly engulfed; then the masticatory apparatus comes into play. This consists of a tongue or lingual riband, armed with five rows of sharp spines, one in the middle, and two on each side.

"The shelled Foraminifera found in the stomach of a Dentalium are perfect, and the sarcode must be extracted from them by some secretion answering to the gastric juice of the Vertebrata. The Dentalium has no eyes; they would be useless to an animal always buried in the sand. They have otolites or ear-stones, which serve as organs of hearing; these are extremely numerous, calcareous and globular, and are enclosed in two nearly spherical pouches, lined with vibratile cilia, which are in constant action, and agitate the otolites by an incessant tremulous movement. The organs of circulation and respiration are of a rudimentary kind; there is no heart. The sexes are separate. There are no external organs of generation, but impregnation is effected by the male emitting his spermatozoa, and the female her eggs at the same time in the water. The process may be compared to the chance shedding of pollen in the air by diœcious plants. Lacaze-Duthiers noticed that the spermatozoa lived six hours after performing the act of fecundation. The egg is at first oval, afterwards pear-shaped, and ultimately divided into segments like those of an Annelid. Such eggs as do not arrive at maturity speedily decompose and are cleared out by swarms of infusoria, which appear to be generated from the corruption. In the first stage of development the germ is motionless; in the second stage it is propelled by vibratile cilia, which are set around a large lobe in front, similar to that observable in the larvæ of many mollusca, and it swims rapidly; in the third stage it crawls by means of a disk-like foot. In swimming it does not come to the surface of the water, as do the fry of the oyster and other mollusca. The shell is formed during the third period, but is only detected by its iridescent lustre, being exceedingly thin and transparent, a mere film. This state continues until the fifth and occasionally the sixth day after birth. The embryonic period lasts from thirty-five to forty days. If any of the fry die, *Paramecia* and *Ploesconia* (infusoria) are bred from the decaying matter, and, entering the shells

of living individuals, soon destroy them. Lacaze-Duthiers observed a current of water passing through the shell from the opening at the smaller end. He discovered the Dentalium at low-water mark, where its presence was betrayed by a small groove in the sand; and he seems to have got a knack of finding them, for he says he easily procured 200 live specimens at the recess of a single high spring-tide. They prefer certain spots, especially patches of coarse sand mixed with broken shells and interspersed with *Zostera*. The Dentalium is hardy, and apparently abstemious. Lacaze-Duthiers kept some alive in a flask of sea-water with a little sand for more than eighteen months. It is much more active at night, and sensible of light. A ray of the sun or the flame of a candle will cause it to withdraw its foot. This organ acts as a piston in expelling at the other end the eggs and seminal fluid, as well as, perhaps, the fæces and exhausted water. The point of the young shell is pear-shaped, and bears some resemblance to a baby's feeding-bottle with the hole at one end instead of in the middle. It is broken off when too small to contain the terminal tube or process of the mantle; and this part of the shell is continually rubbed away as the animal increases in size, until at last it becomes truncated, and a short pipe is formed with an oblique slit in front to accommodate the terminal tube. The slit is extended in certain species, although this distinctive character is confined to adult specimens. The inside of the shell is white as porcelain, and brilliant as varnish. The epidermis is slight and easily abrades. The microscopic structure of the shell is scarcely different from that of *Patella*. It is most complicated, being composed in a great measure of prisms, interlacing fibre, and anastomosing canals—not of cellular elements. The quantity of animal matter which it contains is next to nothing.

“Mr. Lord says that these shells were employed as money by the Indians of Northwest America before the introduction, by the Hudson's Bay Company, of blankets, which to a great extent superseded the tooth-shells as a medium of purchase. ‘A slave, a canoe, or a squaw, is worth in these days so many blankets; but it used to be so many strings of Dentalia.’ The value of a Dentalium depends upon its length. Twenty-five long shells, strung together end to end, make a fathom, and are called a ‘Hi-qua.’ At one time such a string would have been worth about £50 sterling. The shells inhabit the soft sand, in the snug bays and harbors, that abound along the west coast of Vancouver's Island, at a depth of from 3 to 5 feet. The habit of the Dentalium is to bury itself in the sand, one end of the shell being invariably downwards, and the other end close to the surface. ‘This position the wily savage turns to good account, and has adopted a most ingenious mode of capturing the much-prized

shell. He arms himself with a long spear, the shaft made of light deal, to the end of which is fastened a strip of wood placed transversely, but driven full of teeth made of bone, resembling exactly a long comb with the teeth very wide apart. A squaw sits in the stern of the canoe, and paddles it slowly along, whilst the Indian with the spear stands in the bow. He now stabs the comb-like instrument into the sand at the bottom of the water, and after giving two or three such stabs draws it up to look at it; if he has been successful perhaps four or five *Dentalia* have been impaled on the teeth of the spear.' At one period, perhaps a remote one in the history of the inland tribes of Indians, *Dentalia* were worn as ornaments; these are found in old graves, quite 1000 miles from the sea, mixed with stone beads and small bits of nacre of the *Haliotis*, of an irregular shape, but with a small hole drilled through each piece."—JEFFREYS, *Brit. Conch.*

D. ergasticum, a monster species, dredged by the "Travailleur," is nearly four inches (9 cm.) long.

ANTALE, Aldrov. (Pyrgopolon, Montfort. *Entalium*, DeFrance. *Pharetrium*, König.) Shell tubular, much prolonged, smooth, the posterior end with entire margin, the internal tube slightly projecting, and usually with a roundish opening. *D. Tarentinum*, Lam. Europe.

ENTALIS, Gray, 1840. (*Antalis* H. and A. Ad., *ex parte*.) Shell tube-like, slightly curved, longitudinally ribbed or sometimes striated, gradually tapering towards the posterior end, which has the margin on the ventral or convex side provided with a short and broad fissure. Type, *D. entalis*, Linn. *D. Delesserti*, Chenu (ciii, 1). The posterior end is usually longitudinally striated even when these striae or ribbings become obsolete towards the aperture. The supplementary or embryonal projecting tube is not always present, being frequently lost.

FUSTIARIA, Stoliczka, 1868. Shell tubular, thin, usually slightly curved, smooth, posterior end with a long, linear slit on or near the ventral side. *D. eburneum*, Lam.

SUBFAMILY SIPHONODENTALIINÆ.

Posterior aperture of the shell entire or with several notches, and without supplementary tube. Foot elongated, worm-like, provided at the tip with a circular disk, the edges of which are beset with papillæ; edge of the lateral plates of the radula distinctly tridentate. (Order Siphonopoda, Sars.)

The shells resemble the *Dentaliinae*, but as they appear usually to inhabit deep waters they always consist of a thin substance; the posterior end is generally less pointed and more widely opened.

SIPHONODONTALIUM, M. Sars, 1859.

Distr.—*S. vitreum*, Sars (ciii, 100). N. Europe.

Shell slightly attenuated, apex incised-lobate. Terminal pedal disk concave in the middle, no median tentacles.

The posterior orifice exhibits two slight notches on each side, and the foot is ordinarily vermiform and pointed, expanding only in a flower-like shape when the animal uses it as a fulcrum.

PULSELLUM, Stoliczka, 1868. (*Siphonoentalis*, G. O. Sars.) Shell tubular, thin, smooth or longitudinally ribbed, gradually tapering towards the posterior end, which is truncate, with the margin entire. The animals closely resemble those of *Siphodent. vitreum*, only showing slight differences in the ciliated fringe of the foot-disk, but the shells are readily distinguished from it by the entire margin of the posterior end; this distinction also applies as regards Dentalium, but the separation from Antale is more difficult, being apparently restricted to the more truncated shape of the posterior end in the present genus, and to a more hyaline structure of the shell. *S. Lofotensis*, Sars.

CADULUS, Philippi.

Syn.—Gadilia, Gray, 1847. Helonyx, Stimpson, 1865. Gadus, Deshayes.

Distr.—2 sp. Norway, Hong Kong. Fossil, numerous; Palæozoic, Jurassic, Cretaceous, etc. *C. subfusiformis*, Sars (cii, 99).

Shell short, more or less inflated in the middle, apical orifice entire, circular, with annular, suboblique internal plica remote from the apex. Terminal pedal disk concave in the middle, marginal tentacles slightly elongated, median tentacles none?

Cadulus differs from Siphonodentalium by the shell being quite smooth, transparent and lustrous, tumid in the middle or anterior portion, and its mouth encircled by a narrow rim.

DISCHIDES, Jeffreys (1867), 1883.

Distr.—*D. bifissus*, Wood. Europe.

Terminal slits bilateral. Animal whitish, gelatinous; mantle rather thick, forming a collar around the front opening of the shell; captacula issuing from within the mantle, numerous, capable of so great an extension as to exceed the shell in length; stalks very slender; terminal bulbs oval; foot cylindrical and narrow, protruded from the middle of the mouth as from a sheath; it is occasionally thrust out in a darting manner and suddenly withdrawn, and so swiftly that the point of the foot could not be observed; the foot is usually curved towards the point; anal tube protruded beyond the narrower end of the shell—it consists of an outer and inner part, the latter being folded to suit the slit on each side; gills rather short, of a brownish color.—JEFFREYS.

CLASS PELECYPODA.

(*Lamellibranchiata, Conchifera, Bivalves.*)

Accephalous mollusks, or those without a head, are laterally symmetrical, the organs being enclosed in a mantle, one leaf or fold of which envelops each side, and is itself covered and protected by a valve of the bivalve shell—which is always present. They all breathe by means of gills only, and are therefore inhabitants of water, either salt or fresh. The mantle is usually open on the edge, but sometimes its leaves are united more or less, when the mantle is said to be *closed*; it is sometimes tubularly prolonged posteriorly into a siphon. Between the lobes of the mantle lay the gills or branchiæ, two on each side, leaf-like and striate. The most prominent organs of the body are the liver and viscera. The cerebral ganglion is situated above the mouth, and communicates with the other near or distantly situated ganglia. The mouth is at one extremity, the anus at the other; the former is provided with four small, triangular, fleshy leaflets, the extremities of the lips, used partly as tentacles. The heart is in the dorsal region; it has but one ventricle, and the circulation is simple. The foot is a somewhat fleshy mass, atrophied in the adherent species, usually suitable for digging, but rarely very useful for other locomotion. The principal muscles are: (1) those controlling the movements of the foot, which have their insertion upon the valve, partly near the hinge, partly near the adductors, forming pedal scars; (2) the adductor muscles, which, running through the mass of the animal, are inserted upon the middle or sides of each valve, forming adductor scars or impressions. When the adductor muscle is single, it is generally centrally situated, as in the oyster, and such bivalves are termed monomyary; when double, one is at either side of the valve, and such mollusks are termed dimyary. The contraction of these muscles closes the valves; when relaxed, the valves open by reason of an elastic ligament which joins them together at the dorsal or hinge-line.

Mostly dioecious. No sexual union, fertilization being accomplished by the surrounding water containing the male element.

Shell composed of two valves, but with occasionally smaller, supernumerary pieces about the hinge; this latter is either a plain line, or more or less thickened internally, and provided with interlocking teeth and fossets. Some shells, from their shape, cannot be completely closed, or at least portions, front or back, or both, are always gaping.

The form of the shell, number and position of the retractors, scar of the mantle-margin, the hinge, its condition as to teeth,

etc., and position of the hinge-ligament, give some of the principal characters for genera and higher groups; they are, as a rule, and especially for recent shells, rather more satisfactory than the characters used for univalve mollusca.

Order SIPHONIDA. Animal with siphons, and mantle-margin more or less closed.

Order ASIPHONIDA. No siphons; mantle-margins open.

ORDER SIPHONIDA.

Comprises most of the marine bivalve mollusca, including a large portion of the old order Dimyaria—having two well-developed muscular impressions.

Suborder SINUPALLIATA. Siphons long, partly or wholly retractile; the pallial impression upon the inside of the valve having a sinus.

Suborder INTEGRIPALLIATA. Siphons short, not retractile; pallial impression simple, without sinus.

Suborder SINUPALLIATA.

(*Pholadacea*.)

FAMILY GASTROCHÆNIDÆ.

Shell equivalve, gaping; valves thin, edentulous, united by a thin, external ligament, sometimes cemented to a shelly tube when adult; adductor impressions 2, pallial line sinuated.

Animal elongated, truncated in front, produced behind into two very long, united, contractile siphons, with ciliated orifices; mantle-margins very thick in front, united, leaving a small opening for the finger-like foot; gills narrow, prolonged into the branchial siphon.

The shell-fish of this family, the Tubicolidæ of Lamarck, are burrowers in mud or stone. They are often gregarious, living in myriads near low-water line, but are extracted from their abodes with difficulty.

SUBFAMILY ASPERGILLINÆ.

Shell with both valves imbedded in the walls of a tube, with their umbones visible externally. Base of the tube ornamented with radiated tubuli, containing tentacular processes originating in the animal's mantle.

ASPERGILLUM, Lam., 1818.

Watering-pot shell.

Syn.—Clepsydra, Schum., 1817. Brechites, Guett., 1774. Aquaria, Perry, 1811.

Distr.—21 sp. Red Sea, Java, Australia, New Zealand; in sand. Fossil, 1 sp. (*A? Leognanum*, Høning. Miocene; Bordeaux.)

Shell small, equilateral, cemented to the lower end of a shelly tube, the umbones alone visible externally; tube elongated, closed below by a perforated disk with a minute central fissure; siphonal end plain or ornamented with ruffles.

Animal elongated; mantle closed, thickened and fringed with filaments in front; foot conical, anterior, opposed to a minute slit in the mantle; palpi lanceolate; gills long, narrow, united posteriorly, continued into and attached to the branchial siphon.

WARNEA, Gray, 1858. The siphonal end of the tube fringed with from one to several rows of ruffles. *A. vaginiferum*, Lam. (civ, 43). Red Sea.

PENICILLUS, Gray, 1858. Disk surrounded by a single fringe of tubuli; valves not surrounded by wavy depressions on the surface of the tube. *A. dichotomum*, Chenu.

CLEPSYDRA, Gray, 1858. Fringe of the disk consisting of two or three series of tubes; valves not surrounded by wavy depressions on the surface of the tube. *A. strangulatum*, Chenu.

FÆGIA, Gray, 1840. Valves not surrounded by wavy depressions; covered more or less by a sunken tubercle in front; disk of the tube fringed. *F. agglutinans*, Lam.

ARYTENE, Gray, 1858. Like Fægia, but the disk not fringed. *A. Recluzianum*, Chenu.

HUMPHREYA, Gray, 1858. Tube attached by its base to a shell or stone and much distorted in growth. *H. Strangi*, A. Ad. (civ, 44). Australia.

SUBFAMILY CLAVAGELLINÆ.

Shell with the right valve only free, the left being imbedded in the tube; with or without radiated tubuli on the lower end of the tube.

CLAVAGELLA, Lamarck, 1807.

Distr.—6 sp. Mediterranean, Australia, Pacific; 11 fathoms. Fossil, 14 sp. Cretaceous—; Britain, Sicily, Southern India.

Shell oblong, valves flat, often irregular or rudimentary, the left cemented to the side of the burrow, when adult, the right always free; anterior muscular impression small, posterior large, pallial line deeply sinuated. Tube cylindrical, more or less elongated, sometimes divided by a longitudinal partition; furnished with a succession of siphonal fringes above, and terminating below in a disk, with a minute central fissure, and bordered with branching tubuli.

Animal with the mantle closed in front, except a minute slit for the foot, and furnished with tentacular processes; palpi long

and slender; gills 2 on each side, elongated, narrow (floating freely in the branchial siphon?).

Some specimens of the recent *C. aperta* have 3 frills to their tubes; *C. bacillaris* has twice that number occasionally. They are formed by the siphonal orifices when the animal continues elongating, after having fixed its valve and ceased to burrow; or perhaps, in some instances, when it is compelled to lengthen its tubes upwards by the accumulation of sediment. Brocchi mentions that on breaking the tube of the fossil *C. echinata*, he sometimes found the shell of a *Saxicava* or *Petricola* beside the loose valve of the *Clavagella*, into whose tube they must have entered after its death. *C. elongata* is found in coral; *C. Australis* lives at low tide, and spurts out water when alarmed.

CLAVAGELLA (restricted). Only known in a fossil state, having the lower end of the tube surrounded by hollow spinous processes.

STIRPULINA, Stoliczka. Valves ovate, subequal, similar to those of *Clavagella*, but tubuli formed only at the front part of the tube which has a distinct fissure; tube long. *Clavagella coronata* or *bacillaris* of Desh. A fossil group only.

BRYOPA, Gray, 1840. (Recent.) Lower end of tube simple; siphonal end frilled. *C. aperta*, Sowb. (civ, 45). Mediterranean Sea.

DACOSTA, Gray, 1840. (Recent.) Lower and siphonal ends of tube both simple. *C. Australis*, Sowb.

SUBFAMILY GASTROCHÆNINÆ.

Shell with both valves free from the tube.

GASTROCHÆNA, Spengler, 1780.

Syn.—*Chæna*, Retz., 1788. *Fistulana*, Brug., 1789.

Distr.—3 sp. Madagascar, India, Philippines, Australia; burrowing in sand or mud. Fossil. Cretaceous; United States, Europe, Southern India. *G. mumia*, Spengler (cv, 67, 68). Philippines.

Shell elongated, narrow, contained within a shelly tube; posterior adductor nearly central, with a pedal scar in front; siphonal inflection angular, with its apex joining the pallial line. Tube round, straight, tapering upwards, transversely striated, closed at the lower end when complete, and furnished with a perforated diaphragm behind the valves.

Animal elongated, rounded, cephalic extremity swollen; siphons united, long.

ROCELLARIA, Bellevue, 1802.

Syn.—*Gastrochæna*, Cuv., 1817. *Roxellaria*, Agassiz.

Distr.—10 sp. West Indies, Britain, Canaries, Mediterranean,

Red Sea, India, Mauritius, Pacific Islands, Galapagos, Panama; 30 fathoms. Fossil, 20 sp. Inf. Oolite—; Europe, United States. *R. hians*, Chemn. (civ, 46). W. Indies.

Shell regular, wedge-shaped, umbones anterior; gaping widely in front, close behind; ligament narrow, external; pallial sinus deep; tube irregular.

Animal with mantle closed, and thickened in front; foot finger-like, grooved, sometimes byssiferous; siphons long, separate only at their extremities; lips simple, palpi sickle-shaped, gills unequal, prolonged freely into the branchial siphon.

R. modiolina perforates shells and limestone; its holes are regular, about two inches deep and a half inch diameter; the external orifice is hour-glass shaped, and lined with a shelly layer which projects slightly. When burrowing in oyster-shells it often passes quite through into the ground below, and then completes its abode by cementing such loose material as it finds into a flask-shaped case, having its neck fixed in the oyster-shell; in some fossil species the siphons were more separated, and the flasks have two diverging necks. The siphonal orifices are rarely four-lobed.

SPENGLERIA, Tryon, 1861. Valves elongate-cuneiform, truncated at the posterior end, with an elevated, transversely lamellated portion radiating from the beaks to the posterior margin. *R. rostrata*, Spengler (civ, 47). West Indies.

CUCURBITULA, Gould, 1861.

Distr.—*C. cymbia*, Spengl. (cv, 69). China.

Shell regular, elongate, equi-valve, gaping the whole length, anteriorly enveloped by the mantle of the animal.

Tube very short, ovate or gourd-shaped, composed of successive calcareous layers or cups involving bits of shell or sand. Attached by one side to shells, etc.

FAMILY TEREDIDÆ.

Animal vermiform, its two long siphons furnished at their extremity with each a testaceous pallet; valves gaping, with an interior spoon-shaped process proceeding from the hinge. Animal and valves contained within an irregular calcareous tube, with which it lines its perforations in timber and clay.

TEREDO, Linn., 1757.

Distr.—21 sp. Norway, Britain, Black Sea, Tropics, 119 fathoms. Fossil, 24 sp. Lias—; United States, Europe. *T. navalis*, Linn. (civ, 48); U. S. *T. Norvegica*, Spengler (cv, 70-73).

Shell globular, open in front and behind, lodged at the inner extremity of a burrow partly or entirely lined with shell; valves

three-lobed, concentrically striated, and with one transverse furrow; hinge-margins reflected in front marked by the anterior muscular impressions; umbonal cavity with a long, curved, muscular process.

Animal worm-like; mantle-lobes united, thickened in front, with a minute pedal opening; foot sucker-like, with a foliaceous border; viscera included in the valves, heart not pierced by the intestine; mouth with palpi; gills long, cord-like, extending into the siphonal tube; siphons very long, united nearly to the end, attached at the bifurcation and furnished with two shelly pallets or styles; orifices fringed.

T. navalis is ordinarily a foot long, sometimes two and a half feet; it destroys soft wood rapidly, and teak and oak do not escape; it usually bores in the direction of the grain, unless it meets the tube of another *Teredo* or a knot in the timber. In 1731–2 it did great damage to the piles in Holland, and caused still more alarm: metal sheathing and broad-headed iron nails have been found most effectual in protecting piers and ship-timbers. The *Teredo* was first recognized as a bivalve mollusk by Sellius, who wrote an elaborate treatise on the subject in 1733.—FORBES.

T. corniformis, Lamarek, is found burrowing in the husks of cocoa-nuts and other woody fruits floating in the tropical seas; its tubes are extremely crooked and contorted, for want of space. The fossil wood and palm-fruits (*Nipadites*) of Sheppy and Brabant are mined in the same way.

T. Norvegica and *T. nana* are divided longitudinally and also concamerated by numerous, incomplete, transverse partitions at the posterior extremity of the tube.

I annex Dr. J. Gwyn Jeffreys' excellent account of this mollusk:

"The *Teredo* is an anomaly. It consists of a long and nearly gelatinous worm-like body, without rings or segments, terminating at one end in a pair of hemispherical valves, that somewhat resemble the two halves of a split nutshell which has had a large slice cut off at each side, and at the other end in a pair of symmetrical shelly paddles with handles of different lengths, which close this extremity at the will of the animal. The open part of the bivalve shell is placed at the further end, and receives a circular disk, of a fleshy or rather muscular nature, which may be termed the foot; this is the broadest or widest part. Inside each valve is seen a curved process, like a bill-hook, that projects from the hinge at a right-angle. The shell covers and protects the mouth, palps, liver and other delicate organs. The body tapers gradually to the outer or nearer end, where it becomes quite small and attenuated; it contains the gullet, intestines and gills, and is enveloped in a thin membrane or mantle, which forms at the outer end two cylindrical

tubes (siphons), mostly of unequal length. The larger tube (siphon) takes in infusoria or similar animalcules, which constitute the food of the Teredo, as well as imbibes water charged with air for the purpose of respiration and keeping the whole fabric moist; while the smaller tube is employed to eject the water which has been exhausted or deprived of its aeriferous qualities, and also serves to get rid of the woody pulp that is excavated by the Teredo. Both tubes form a kind of hydraulic machine. At the base of each lies one of the paddles, often termed 'pallets,' and which may be translated into scientific language as 'claustra.' When the Teredo is alarmed or not feeding, it withdraws its tubes into the neck of its sheath or shelly cylinder; and the pallets, which had been previously kept pressed against the sides, then spring forward and close the opening, so as to form an efficient barrier against all foes, whether crustacea or annelids. This complicated animal mechanism is entirely enclosed in the sheath or cylinder above mentioned, which is secreted by the mantle, and varies considerably in thickness and extent. The inside of the sheath is, at its outer or narrower end, divided into short strips or ledges, arranged in an imbricated fashion; the last-formed of these ledges serves as a *point d'appui* for the blades of the paddles, and it greatly assists the Teredo in closely shutting its doors. The whole of what I have above endeavored to describe is found only within some hard vegetable substance, either the hull of a vessel or boat, a harbor pile, a shipping-stage, a floating tree or the roots of one growing on the banks of an estuarine river. The food of the Teredo consists entirely of minute organisms, that are introduced with the water into the incurrent or branchial tube, and it does not consume the wood as any part of its nourishment. Nor do I believe that the eroded material undergoes any chemical change, either in the stomach of the Teredo or in the passage outwards through the intestine, although in the latter receptacle it is closely compressed. When it is voided or expelled by the excurrent tube, and separated in the water, it becomes a flocculent mass of pulp, like that of paper, composed of extremely minute and fine particles of an irregular size and shape, but still retaining its fibrous structure. It does not exhibit any appearance of having been digested."

CALOBATES, Gould, 1862. Siphonal pallets large, long, stilt-shaped, siphons adherent, only becoming free at the tips. *T. furcelloides*, Gray. 2 sp. Burmack, Australia.

NAUSITORA, Wright, 1864. Siphonal pallets, outer surface convex, covered with thick scale-like striæ, inner flat or slightly concave. *N. Dunlopi* (fresh-water, India). 2 sp. Burrowing in wood. Bengal, Australia.

LYRODUS, Gould. This name is given for a small American

species, *T. chlorotica*, the pallets of which are elongated, with the basal portion, thin, flexuous, the upper lyre-shaped, the extreme two-thirds of their length being covered with a dark crust which has a projecting horn at each angle. The form of these pallets very closely resembles that of *Nausitoria*, when the tip is broken away; it may belong to the same genus.

? TEREDOLITES, Desh. For a cretaceous species, *T. clavatus*, only known by some tubes which are short, clavate, and in position, as they occur in the rock or wood, almost parallel to each other.

[POLORTHUS, Gabb. See page 53, vol. ii.]

XYLOTRYA, Leach, Gray, 1847.

Syn.—*Bankia*, Gray.

Distr.—10 or 12 sp. Universal. *X. palmulata*, Lam. (civ, 74). E. Indies.

Siphonal pallets elongated and penniform, the blade consisting of articulated pieces radiating obliquely from the style. A species occurs in the fossil wood of the Greensand of Blackdown, England.

UPEROTIS, Guettard.

Syn.—*Guettera*, Gray.

Distr.—*U. clava*, Gmel. (civ, 49). Tranquebar.

Tube club-shaped, straight or contorted, growing together in masses; pallets oval, jagged; valves narrow and elongated.

KUPHUS, Guettard.

Syn.—*Furcella* and *Septaria*, Lam. *Clauseria*, Menke.

Distr.—*K. arenarius*, Linn. (civ, 50-52). Philippines.

Tube penetrating sand, somewhat irregular, very large; pierced around the base with small scattered perforations, and inclosed by two overlapping convex septa arising from the sides and completely closing the end. These septa appear to replace the valves.

The tube of the giant *Teredo* is often two yards long and two inches in its greatest diameter; when broken across it presents a radiating prismatic structure. The siphonal end is divided lengthwise, and sometimes prolonged into two diverging tubes.

TEREDINA, Lam., 1818.

Distr.—*T. personata*, Lam. (civ, 53, 54). Eocene; Europe.

Valves with an accessory plate in front of the umbones; free when young, in the adult connected with the tube. The tube is sometimes concamerated; its siphonal end is often truncated; and the opening contracted by a lining which makes it hour-glass shaped, or six-lobed.

The possession of an accessory dorsal valve connects this genus with the next family; no siphonal pallets have been discovered.

FAMILY PHOLADIDÆ.

Shell gaping at both ends; thin, white, brittle, and exceedingly hard; armed in front with rasp-like imbrications; without hinge or ligament, but often strengthened externally by accessory valves; hinge-plate reflected over the umbones, and a long curved muscular process beneath each; anterior muscular impression on the hinge-plate; pallial sinus very deep.

Animal club-shaped; foot short and truncated; mantle closed in front, except the pedal orifice; siphons large, elongated, united nearly to their ends; orifices fringed; gills narrow, prolonged into the exhalent siphon, attached throughout, closing the branchial chamber; palpi long.

The cartilage of the hinge in these shells is small and internal; the ligament is strong and elastic, situated externally, and both are further strengthened by an accessory membrane formed by the coriaceous end of the mantle, which issues between the anterior ends of the valves and covers the ligament; this extension of the mantle is fixed by filaments which enter the dorsal cells and is furnished usually with calcareous plates which maintain the valves in position.

The Pholadidæ perforate rocks, wood or clay; the burrows are vertical, quite symmetrical, and seldom in contact.

SUBFAMILY PHOLADINÆ.

Valves with an anterior gap which is never closed in the adult shells.

PHOLAS, Linn., 1757.

Etym.—*Pholas*, a burrowing shell-fish, from *pholeo*, to bore. Piddock.

Syn.—Hypogæa and Hypogæoderma, Poli.

Distr.—*P. costata*, Linn. (civ, 55–57). U. S. Fossil; Jurassic, Cretaceous, Tertiary.

Shell elongated, cylindrical; dorsal margin protected by two accessory valves; anterior and posterior in position; umbonal processes reflexed over the beaks, closely applied. Pallial sinus reaching the centre of the shell.

Animal with a large truncated foot, filling the pedal opening; body with a fin-like termination; combined siphons large, cylindrical, with fringed orifices. *P. costata* is sold in the market of Havana, where it is an article of food.

Mr. W. Woods remarks that on the coast of Normandy the Pholads are eaten in abundance, well seasoned and cooked with fine bread-crumbs and herbs. They are also reckoned a delicacy when pickled in vinegar. In the neighborhood of Dieppe a great many women and children, each provided with an iron

pick, are employed in collecting them, either to sell in the market, or for fishermen's bait. They are almost entirely littoral,

"Entomb'd upon the very hem o' the sea."

The property which they possess of shining in the dark is very remarkable.

CYRTOPLEURA, Tryon, 1862. Margins of the valves emarginate anteriorly, forming a short, wide hiatus. 3 sp. U. S., Panama, Philippines.

DACTYLINA, Gray, 1847.

Distr.—3 sp. *D. dactylus*, L. (civ, 58, 59). Europe.

Shell oblong-oval, anteriorly emarginate; cardinal margin reflected over the back of the shell, from which it is separated by numerous horizontal plates, covered by two dorsal accessory valves, arranged side by side, their nuclei at their outer margins, posterior to the centre.

Siphons naked to the base; orifice of the branchial siphon ciliated, that of the anal siphon simple or crenulated.

The common piddock is used for bait on the Devon coast (England); its foot is white and translucent when fresh, like a piece of ice; the hyaline stylet lodged in it is large and curious.

GITOCENTRUM, Tryon, 1862. Valves not emarginate anteriorly, but regularly rounded, forming a long, narrow hiatus; nuclei of the dorsal valves anterior, situated nearer the inner margin. 2 sp. Southern U. S., W. Indies, Chili. *D. campechensis*, Gmel.

BARNEA (Leach), Risso, 1826.

Distr.—9 sp. Australia, Burmah, Red Sea, Europe, Patagonia, Philippines. *B. candida*, Linn. Europe.

Shell oval-oblong; anteriorly gaping; a single lanceolate dorsal accessory valve; umbonal process reflexed, closely applied.

BARNEA (typical). Anterior margins regularly rounded, forming a long, narrow hiatus.

ANCHOMASA, Leach. Ventral anterior margin of the valves emarginate, the hiatus short and wide. *B. parva*, Pennant. Europe.

MONOTHYRA, Tryon, 1862.

Distr.—*M. orientalis*, Gmel. (civ, 60). India.

Dorsal valve ovate-cuneiform; reflexed umbonal processes cellular beneath.

XYLOPHAGA, Turton, 1822.

Etym.—*Xulon*, wood, *phago*, to eat.

Distr.—3 sp. Norway, Britain, Western South America, Mergive Is. Bores an inch deep, and across the grain, in floating wood, and timbers which are always covered by the sea. A few tertiary species. *X. dorsalis*, Turton (cv, 77-79). England.

Shell globular, with a transverse furrow; gaping in front,

closed behind; pedal processes short and curved; anterior margins reflected, covered by two small accessory valves; burrow oval, lined with shell.

Animal included within the valves, except the slender contractile siphons, which are furnished with pectinated ridges, and divided at the end; foot thick, very extensile.

TURNUS, Gabb.

Distr.—Cretaceous; California, India. *T. plenus*, Gabb.

Shell like that of *Xylophaga*, but has posterior to the internal umbonal rib another, often broader rib, running from behind the apex to the infero-posterior margin.

The animal also secretes a shelly tube, and consequently the valves must have been much more gaping posteriorly than they are in the recent *Xylophagæ*, which only slightly protrude out of their shells. The accessory valves are unknown, and it is therefore difficult to classify exactly the genus, for it may be just as possible that it is a form of the *Teredininae*.

TURNUS, Gabb. (Typical.) Shell transversely oval; anterior hiatus formed by the oblique truncation and slightly sinuous outline of the anterior ventral margins of the valves; umbonal sulcus and both of the internal ridges very oblique, narrow, smooth, and extending to the free margins. *T. plenus*, Gabb.

GONTOCHASMA, Meek. Shell transversely ovate-oblong; hiatus formed by a deep rectangular notch in the anterior ventral margins; umbonal sulcus and corresponding internal ridge slightly oblique, and the latter finely and obscurely crenate; posterior internal ridge broad, deep, very oblique, smooth; and not extending to the free margins. *G. Stimpsoni*, M. and H.

XYLOPHAGELLA, Meek. Shell globose; anterior hiatus formed by a large, deep, rectangular notch in the anterior ventral margins; umbonal sulcus and corresponding internal ridge descending vertically, the latter being strongly crenate by little projecting points; posterior internal ridge as in the last, excepting that it is less oblique and placed in front of the posterior umbonal slopes. *X. elegantula*, M. and H. (cv, 76).

ZIRPHÆA, Leach, 1851.

Distr.—3 sp. Europe, U. S., Senegal, Straits of Sunda. *Z. crispata*, Linn. (civ, 61).

Shell oval, cardinal margin scarcely reflected; no accessory valves, the beaks protected by a membrane; usually a thin, fugacious epidermis; anteriorly greatly gaping.

TALONA, Gray, 1847.

Distr.—*T. explanata*, Spengler (civ, 62; cv, 84). W. Africa.

Shell narrowly gaping anteriorly; two accessory dorsal plates,

lateral and divergent. Base of siphons protected by corneous or calcareous sheaths.

NAVEA, Gray, 1851.

Distr.—3 sp. California. *N. subglobosa*, Gray (cv, 80, 81).

Shell oval, widely gaping anteriorly, close posteriorly; surface divided by a subcentral groove; dorsally covered by a coriaceous epidermis (striated behind the interior spatulate processes), under which is a small transverse posterior dorsal valve.

SUBFAMILY JOUANNETINÆ.

Anterior ventral gap closed in the adult by a callous plate.

PHOLADIDEA, Turton, 1819.

Syn.—Cadmusia, Leach.

Distr.—8 sp. W. Coast of N. America, New Zealand. *P. papyracea*, Sol. (cv, 82, 83).

Shell globose-oblong, with a transverse furrow; anterior gap large, closed in the adult by a callous plate; two minute accessory valves in front of the beaks.

Animal with a fringed disk at the end of the combined siphons, and a horny cup at their base (in adults).

HATASIA, Gray, 1851. Siphonal cups or valves with a tubular shelly prolongation. *P. melanura*, Sowb.

TALONELLA, Gray, 1851. Siphonal valves without any tubular prolongation, and with a longitudinal and transverse fold. *P. tridens*, Gray.

NETASTOMELLA, Carp. Based upon *Ph. Darwinii*, Sowb., 1865. The valves are posteriorly prolonged into a flattened calcareous cup. Differs from Jouannetia in having both valves equal, and from Pholadidea by the calcareous nature of the cup at the posterior end of the shell.

JOUANNETIA, Desmoulins, 1828.

Syn.—Triumphalia, Sowb., 1849.

Distr.—2 sp. Philippines.

Shell very short, subglobose, with two impressed radiating grooves; right valve longest behind; anterior opening closed by a callous plate developed from the left valve overlapping the margin of the right valve, and fixed to the single unsymmetrical umbonal plate.

PHOLADOPSIS, Conrad, 1849. Valves with a single subcentral radiating groove. *J. pectinata*, Conr. (cv, 63). California.

PARAPHOLAS, Conrad, 1848.

Distr.—2 sp. California, Australia. Fossil; Cretaceous. *P. Californica*, Conr. (cv, 64).

Shell oval-oblong; anterior gap closed by a thin, swollen, glo-

bose callous plate; valves equal, divided by two radiating grooves into three portions; two dorsal valves.

PENITELLA (Valenciennes), Conrad, 1849.

Distr.—*P. penita*, Conr. (civ, 65). California.

Anterior dorsal plates two, placed side by side, posterior to which is a central plate directly over the umbones; base of the siphons protected by reflected appendages.

MARTESIA, Leach, 1847.

Distr.—13 sp. World-wide. Fossil; Cretaceous and Tertiary. *M. striata*, Linn. (civ, 66).

Valves lengthened behind when full-grown, by a plain border; umbonal valves one or two, dorsal and ventral margins often with narrow accessory valves; surface impressed with one or more furrows. *M. striata* burrows in hard timber. *M. terediniformis* was found in cakes of floating wax on the coast of Cuba. (G. B. Sby.) *M. Australis* in (fossil?) resin, on the coast of Australia. *M. rivicola* in timber twelve miles from the sea, in Borneo (fresh-water). *M. scutata*, Eocene, Paris, lines its burrow with shell.

MARTESIA (restricted). One accessory dorsal plate.

DIPLOTHYRA, Tryon, 1862. Shell with a double accessory valve; the principal plate directly over the umbones, with a smaller anterior one adjoining. *M. Smithii*, Tryon. Staten Island, N. Y., and Chesapeake Bay, burrowing in oyster-shells.

PHOLAMERIA, Conrad, 1865. The shell has the form of a short Martesia, but without accessory plates; nothing else, however, occurs in the specific description which would indicate any peculiarity to justify the formation of a new genus. *M. triquetra*, Conr. Tert.; U. S.

SCHRÖTERIA, Tryon, 1862. Has one preumbonal plate; the anterior hiatus is probably closed. *M. cordata*, Schröter.

(*Solenacea*.)

FAMILY SOLENIIDÆ.

Shell elongated, gaping at the ends; ligament external; hinge-teeth usually 2-3, compressed, the posterior bifid. External shell layer with definite cell-structure, consisting of long prisms, very oblique to the surface, and exhibiting nuclei; inner layer nearly homogeneous.

Animal with a very large and powerful foot, more or less cylindrical; siphons short and united (in the typical Solens, with long shells) or longer and partly separate (in the shorter and more compressed genera); gills narrow, prolonged into the branchial siphon.

SUBFAMILY SOLENINÆ.

Siphons short and united, foot more or less cylindrical and obtuse. Shell elongated, transverse, truncate at both extremities; hinge nearly terminal; usually with a single tooth in each valve; pallial line profoundly sinuated and truncated.

SOLEN, Linn., 1757.

Etym.—Razor-shell.

Syn.—Hypogæa and Hypogæoderma, Poli.

Distr.—37 sp. World-wide, except Arctic seas; 100 fathoms. Fossil, 40 sp. ? Silur., Carb.—; United States, Europe. *S. vagina*, Linn. (cvi, 6).

Shell very long, subcylindrical, straight, margins parallel, ends gaping; beaks terminal, or subcentral; hinge-teeth, one in each valve; ligament long, external; anterior muscular impression elongated; posterior oblong; pallial line extending beyond the adductors; sinus short and square.

Animal with the mantle closed except at the front end, and a minute ventral opening; siphons short, united, fringed; palpi broadly triangular; foot cylindrical, obtuse.

In this genus the mantle is produced behind into a truncate siphonal sheath which contains the two short siphons which are never extended beyond the shell. The animal has the power of changing the terminal portion of the foot from a tapering point to an obtuse club. By suddenly extending the foot it is enabled to ascend rapidly the deep burrow it forms in the sand.

The annexed additional account of the Solen is from "British Conchology," by Dr. J. Gwyn Jeffreys:

"The razor-fishes (or 'spout-fishes,' as they were called by Grew and other naturalists of former days) usually burrow in the sand at the verge of low-water mark, not perpendicularly, but in a slanting direction at an angle of about 60 degrees. On the retreat of spring-tides, they may be seen nearly half out of their holes, apparently taking in a supply of oxygen for their gills. They are evidently sensible of vibratory movements in the air, as well as on ground, taking alarm at greater or less distances according to the state of the atmosphere and direction of the wind. When the Solen is disturbed it squirts out water in a strong jet; and having thus compressed the volume of its body, it lengthens and darts out its dibble-shaped foot, and rapidly disappears below the surface to a depth of two or three feet. A Solen-hunt requires considerable alertness; for if you cannot approach near enough to catch them when partly exposed to view—and this is not easy, their muscular strength being, in proportion to their size, far greater than that of man—and you delve with your hands after them, they will probably beat you in the race. The stake is much more important to them than to

you, and it calls for all their energies. Fishermen entice them out of their holes by a pinch of salt, making (as they say) the razor-fish believe that the tide is coming in. Reaumur, however, considers that the salt irritates them, and causes a painful pricking sensation in the mantle, which induces them to rise to the surface and endeavor to get rid of the annoyance by expelling the salt backwards. He also noticed the blind instinct which the Solen has when taken out of its hole, and held between the fingers in the open air, suspended vertically: it protrudes its foot several times in succession, as if it were in the act of burrowing into its native sands. The account given by Poli of Solen-fishing in Naples is curious. We know that the flow and ebb of the tide there are very slight, and different from what takes place on our own British shores. He tells us that the lurking-place of the Solen is betrayed by a hole in the sand, agreeing in shape with the apertures of its tubes or siphons. Where the water is shallow the fisherman sprinkles some oil on the surface, in order to see these marks more clearly. He then steadies himself by leaning on a staff with his left hand, and feels for the Solen with his naked right foot. This he catches and holds between his big toe and the next; but although his toes are protected by linen bands, the struggles of the Solen to escape are so violent, and the edges of the shell so sharp, that very often a severe wound is inflicted by it. When the sea is five or six feet deep, another mode of fishing is adopted. It consists in the fisherman diving or swimming under water with his eyes open, and, after having found the holes, digging with his hands for the razor-fish. Sometimes the Solen so forcibly resists being taken, that it will suffer its own foot to be torn away, or will even die rather than surrender. Their power of locomotion is not limited to burrowing; they can dart from place to place in the water as quickly as a scollop, and apparently in the same way."

SOLENA, Brown, 1756. (*Hypogella*, Gray. *Plectosolen*, Conr.) Shell rounded at each extremity; hinge nearly terminal; anterior muscular impression rounded. Scarcely distinguishable from the typical group. 3 sp. Cuba, Philippines, Panama. *S. obliqua*, Spengler (cvi, 7).

ENSIS, Schumacher, 1817.

Syn.—*Ensotella*, Swains., 1840.

Distr.—14 sp. U. S., Europe, Patagonia, Philippines, Australia. *E. ensis*, Linn. (cvi, 8). *E. siliqua*, Linn. (cvi, 9).

Shell elongated, transverse, gaping and rounded-truncate at its extremities, straight or somewhat curved; hinge composed of two teeth in one valve and three in the other; anterior muscular impression elongated, horizontal; pallial impression with a short truncated sinus; siphons short, divided.

SOLENOPSIS, M'Coy, 1844.

Distr.—*S. minor*, M'Coy (cv, 85). Carboniferous; Ireland.

Shell like *Solen*, but somewhat thicker anteriorly, and with inflated beaks; posterior end truncate.

This genus has been proposed for the reception of some palæozoic species, formerly described as *Solen*, like *S. pelagicus* and *vetustus* of Goldfuss, *S. siliquoides*, Kon., and others. The general form of these shells is very much like that of elongated species of *Sphenia*; the hinge-teeth, if any, are not as yet known, and it is therefore, strictly speaking, impossible to classify the genus correctly; D'Orbigny identifies it with *Lyonsia*.

SOLENARIA, Stoliczka, 1870.

Distr.—*S. affinis*, Eichw. Turonian; Russia.

Shell thin, narrow, long and straight, like a *Solen*, internally with two radiating, diverging ribs, originating at the beaks and proceeding towards the ventral edge. The hinge is as yet unknown, but the general form of the shell agrees entirely with *Solen*.

CULTELLUS, Schumacher, 1817.

Etym.—*Cultellus*, a knife.

Distr.—12 sp. Africa, India, Nicobar, Philippines. Fossil; Tertiary. *C. cultellus*, Linn. (cvi, 10, 11).

Shell elongated, compressed, rounded and gaping at the ends; hinge-teeth 2·3; beaks in front of the centre, supported internally by an oblique rib; pedal impression behind the umbonal rib; posterior adductor trigonal; pallial line not prolonged behind the posterior adductor; sinus short and square.

Animal (of *C. Javanicus*) with short, fringed siphons; gills narrow, half as long as the shell, transversely plaited; palpi large, angular, broadly attached; foot large, abruptly truncated.

ENSICULUS, H. and A. Ad. Proposed for the old *Solen cultellus*, Linn., differing from the other species of *Cultellus* by its more elongated, curved and parallel form, and the short, oblique ribs below the umbones.

SUBFAMILY PHARELLINÆ.

Siphons elongated, separated for half their length. Shell transverse, elongated, gaping and rounded at the extremities; umbones subcentral, instead of terminal as in *Soleninæ*; hinge-teeth varying, usually three in one valve, two in the other; pallial impression with a profound, rounded sinus.

PHARELLA, Gray, 1854.

Distr.—4 sp. India, East Indies. Fossil. Cretaceous; India, N. America. *P. Javanica*, Lam. (cv, 86).

Shell subcylindrical, transversely elongated, rounded and gaping at the extremities; beaks anterior to the centre; anterior muscular impression elongated, subtrigonal; pallial impression with a small sinus.

Siphons shortly produced and separate; foot large, abruptly truncate. Inhabits the muddy estuaries of rivers.

CERATISOLEN, Forbes.

Syn.—Pharus, Leach, teste Gray, 1840. Polia, d'Orbigny. Solecurtoides, Desm.

Distr.—2 sp. Britain, Mediterranean, Senegal, Red Sea, Singapore. Fossil, 3 sp. Miocene; Italy. *C. legumen*, Linn. (cvi, 12).

Shell narrow, subequilateral, anterior adductor impressions elongated, a second pedal scar near the pallial sinus.

Animal with a long, truncated foot; siphons separate, diverging, fringed.

LEGUMENAIA, Conrad, 1858.

Distr.—*L. elliptica*, Conr. (cvi, 14). Cret.; U. S.

Valves very inequilateral; hinge with two very slender teeth in the right valve under the beak, and one posterior, very oblique, prominent, lamelliform tooth. This group was proposed for a cretaceous species; the form of the teeth and their position agrees with *Novaculina*, but the posterior tooth is not lamelliform in this genus. A character of further importance is stated to be the shortness of the posterior part of the shell, which is not seen in any of the European or Indian cretaceous species; it does, however, occur in some of the recent American species of *Tagelus*, from which *Legumenaia* would differ by its dentition, but externally it would seem impossible to distinguish between both of them.

LEPTOSOLEN, Conrad, 1867.

Distr.—*L. biplicata*, Conr. Cretaceous; U. S.

Elongated, thin in substance, straight, with the dorsal and ventral margins parallel; plicated anteriorly, open at both ends; beaks not nearly terminal; hinge of the right valve with one direct tooth, convex anteriorly, truncated behind; an internal, rounded, direct rib commences under the cardinal margin, gradually becomes less prominent, and disappears towards the ventral margin.

If the existence of a single tooth in the right valve can be considered as a permanent, distinctive character, the separation from *Siliqua* would have good grounds. The tooth is said to be broadest at the hinge-plate, and tapers to a very acute edge, which is expanded in the direction of the shell's diameter. This peculiarity in the form of the principal or cardinal tooth is often

seen in species of *Tagelus*. Externally the type species resembles the recent *Pharellā Javanica*.

SILQUA, Muhlfeldt, 1811.

Syn.—*Leguminaria*, Schum., 1817. *Machæra*, Gld., 1841. *Aulus*, Oken., 1815.

Distr.—20 sp. India, China, Ochotsk, Oregon, Sitka, Behring's Sea, Newfoundland, Atlantic United States. *M. costata*, Say, is often obtained from the maw of cod-fish. Fossil, 4 sp. Upper Greensand—; Britain, France. *S. radiata*, Linn. (cvi, 13).

Shell smooth, oblong; epidermis polished; an umbonal rib extending across the interior of the valve; pallial sinus short.

The animal is similar to *Solecurtus*.

PROTHYRIS, Meek, 1869.

Distr.—2 sp. Carb.; U. S. *P. Meeki*, Winchell (cv, 90).

Shell equivalve, very inequilateral, longitudinally oblong; valves compressed or moderately convex; nearly closed or a little gaping behind, and more or less widely gaping in front, where the hiatus is increased in size by a nearly rectangular notch in the margin, mainly below the middle; beaks depressed and very near the anterior end, with a small ridge usually extending from the anterior side of each to the corner of the anterior marginal notch; dorsal margin without escutcheon or lunule, being erect and sharp behind the beak; surface merely marked with striæ of growth. Hinge and interior unknown.

SOLECURTUS, Blainv., 1824.

Syn.—*Solenocurtus*, Sowb., 1839. *Tagelus*, Gray, 1847. *Siliquaria*, Schum., 1817.

Distr.—11 sp. E. and W. Coasts of N. and S. America, Senegal, Mediterranean. Fossil, 30 sp. Neocomian—; United States, Europe. *S. Dombei*, Lam. (cv, 87).

Shell elongated, rather ventricose, with subcentral beaks; margins subparallel; ends truncated, gaping; ligament prominent; hinge-teeth two in each valve; pallial sinus very deep, rounded; posterior adductor rounded.

Animal very large and thick, not entirely retractile within the shell; mantle closed below; pedal orifice and foot large; palpi triangular, narrow, lamellated inside; gills long and narrow, outer much the shortest; siphons separate at the ends, united and forming a thick mass at their bases; anal orifices plain, branchial fringed.

The *Solecurti* bury deeply in sand or mud, usually beyond low-water, and are difficult to obtain alive. *P. Caribæus* occurs in countless myriads in the bars of American rivers, and on the coast of New Jersey in sand exposed at low-water; by removing three or four inches of sand its burrows may be discovered;

they are vertical cylindrical cavities, one and one-half inches in diameter and twelve or more deep; the animal holds fast by the expanded end of its foot.

MESOPLEURA, Conrad, 1867. Valves with an interior rib crossing from the beak to the opposite margin. 3 sp. U. S., Java, California. *S. centralis*, Say. Atlantic Coast of U. S.

NOVACULINA, Benson. (Loncosilla, Raf.) Shell oblong, plain; epidermis thick and dull; pallial sinus rather small; anterior pedal scar linear. 3 sp. India, China. In the mud of river-estuaries. *N. constricta*, Lam. (cv, 88).

SOLYMA, Conrad. Shell ovately elongated, thin, equilateral, ventricose; right valve with two direct approximate teeth under the beak. Type, *S. lineolatus* (cv, 89). Cretaceous; N. J. Conrad states that the genus is allied to Leptosolen, though as to form it rather appears to exhibit greater relation to some Tellinidæ, and as regards the hinge-teeth of the right valve it is allied to Solecurtus.

MACHA, Oken, 1815.

Syn.—Solecurtus, Blainv. (pt.). Psammosolen, Risso. Cyrtosolen, Herrm.

Distr.—8 sp. West Indies, Mediterranean, East Indies. *M. strigillata*, Linn. (cvi, 15).

Shell transversely oblong, compressed, rounded and gaping at the extremities, obliquely striate, more or less invested with an epidermis, beaks subcentral, margins nearly parallel; hinge with two diverging primary teeth in each valve; ligament prominent; anterior muscular impression lobed; pallial impression deeply sinuated.

Siphons very large, united at the base; the branchial orifice fringed, anal free. The animal is very large and not entirely retractile within the shell. Usually lives buried in sand, coral-line zone.

AZOR, Gray, 1847. Valves smooth, covered by an epidermis. 5 sp. Europe, Philippines. *M. coarctata*, Gmel. (cvi, 16).

(*Myacea.*)

FAMILY SAXICAVIDÆ.

Shell equivalve, thick, gaping at the extremities; hinge with a single cardinal tooth; ligament external, prominent, solid; inserted in a nymphal callosity; pallial impression irregular, sinuous.

Animal elongated, symmetrical; mantle-lobes united, with a small opening for the digitiform foot; siphons large, elongated, covered with a thick skin, the orifices fringed. The Saxicavidæ live in sand, mud or soft rock, excavating the latter. There are but few living species, but the extinct forms are numerous.

.SAXICAVA, Bellevue, 1802.

Etym.—*Saxum*, stone; *cavo*, to excavate.

Syn.—Byssomya, Cuv., 1817. Rhomboides, Bl. Hiatella, (*minuta*), Daud., 1799. Biapholius, Leach. Arcinella (*carinata*), Phil. Clotho, Faujas Saint-Fond, 1807.

Distr.—12 sp. Universal. Fossil; Jurassic, Cret. ? Tert.—.

Shell when young symmetrical, with two minute teeth in each valve; adult rugose, toothless; oblong, equivalve, gaping, ligament external; pallial line sinuated, not continuous.

Animal with mantle-lobes united and thickened in front; siphons large, united nearly to their ends, orifices fringed; pedal opening small, foot finger-like, with a byssal groove; palpi small, free; gills narrow, unequal, united behind and prolonged into the branchial siphon.

Five genera and fifteen species have been manufactured out of varieties and conditions of the Protean *S. rugosa*, Linn. (cv, 91, 92). It is found in crevices of rocks and corals, and amongst the roots of sea-weed, or burrowing in limestone and shells; at Harwich (England) it bores in the cement stone (clay iron-stone), at Folkestone in the Kentishrag, and the Portland stone employed in the Plymouth Breakwater has been much wasted by it. Its crypts are sometimes six inches deep (Couch); they are not quite symmetrical, and like those of the *Lithodomus*, are inclined at various angles, so as to invade one another, the last comers cutting quite through their neighbors; they are usually fixed by the byssus to a small projection from the side of the cell. The *Saxicava* ranges from low-water to 140 fathoms; it is found in the Arctic seas, where it attains its largest size; in the Mediterranean, at the Canaries, and the Cape. It occurs fossil in the Miocene tertiary of Europe and in the United States, and in all the glacial deposits.

Sometimes they do considerable damage to sea-walls. In the young state, *Saxicava rugosa* gapes at the superior margin, and the hinge is composed of a small tooth in the right valve, and two rather larger oblique teeth in the left valve; in this condition it is the *Hiatella* of Daudin, and the *Arcinella carinata* of Philippi.

“Successive generations will occupy the same hole. The last inhabits the space between the valves of its predecessor. In this way four or five pairs of shells may be frequently seen nested one within the other, and not unusually a *Sphenia Binghami* in the centre of all. Cailliaud observed a *Saxicava* within a specimen of *Venerupis Irus*, which it had perforated.”—JEFFREYS, *Brit. Conch.*

PARAMYA, Conrad, 1860. (*Myalina*, Conrad, 1838, not Koninck.) Shell subovate, inequilateral, ventricose over the umbonal slope, slightly flattened from beak to base; surface with irregular

concentric lines; ligament and basal margins straight, parallel; a spoon-shaped fosset in each valve, the lateral margins of which are carinated, and the base emarginated. *S. subovata*, Conr. Miocene; Virginia.

PANOPÆA, Menard de la Groye, 1807.

Etym.—*Panopè*, a Nereid. *Syn.*—*Glycimeris*, H. and A. Ad.

Distr.—11 sp. Northern seas, Mediterranean, Cape, Australia, New Zealand, Patagonia. Low-water—ninety fathoms. Fossil, 140 sp. Inferior Oolite—; United States, Europe, India.

Shell equivalve, thick, oblong, gaping at each end; ligament external, on prominent ridges; one prominent tooth in each valve; pallial sinus deep.

Animal with very long, united siphons, invested with thick, wrinkled epidermis; pedal orifice small, foot short, thick, and grooved below; gills long and narrow, extending far into the branchial siphon, the outer pair much narrower than the inner, faintly pectinated; palpi long, pointed, and striated.

In *P. Norvegica* the pallial line is broken up into a few scattered spots, as in *Saxicava*; the animal itself is like a gigantic *Saxicava*. This species ranges from Ochotsk to the White Sea, Norway, and North Britain; it was formerly an inhabitant of the Mediterranean, where it now occurs fossil. (= *P. Bivonæ*, Philippi.) The British specimens have been caught, accidentally, by the deep-water fishing-hooks. *P. Natalensis* is found at Port Natal, buried in the sand at low-water; the projecting siphons first attracted attention (doubtless by the strong jets of water they sent up when molested), but the shells were only obtained by digging to the depth of several feet. The Mediterranean species *P. glycimeris*, attains a length of six or eight inches.

GLYCIMERIS, Klein, 1753. (*Panopæa*, H. and A. Adams. *Panomya*, Gray.) Pallial line broken up into punctations, posterior impression much lengthened. Recent, miocene and pliocene. *P. glycimeris*, Born (cvii, 29–31).

CYRTODARIA, Daudin, 1799.

Syn.—*Glycimeris*, Lam., 1801.

Distr.—2 sp. Arctic seas, Cape Parry, Northwestern America, Newfoundland. Fossil. Pliocene—; Britain, Belgium. *C. siliqua*, Chemn. (cvi, 17; cvii, 32).

Shell oblong, gaping at each end; posterior side shortest; ligament large and prominent; hinge thick, without teeth; epidermis black, extending beyond the margins; anterior muscular scar long, pallial impression irregular, slightly sinuated.

Animal larger than its shell, subcylindrical; mantle closed, siphons united, protected by a thick envelope; orifices small; pedal opening small, anterior; foot conical; palpi large, striated inside, the posterior border plain; gills large, extending into the branchial siphon.

FAMILY MYACIDÆ.

Shell thick, strong and opaque; left valve with a spatulate cartilage-process, gaping posteriorly; pallial line sinuated; epidermis wrinkled. Structure more or less distinctly cellular, with dark nuclei near the outer surface; cartilage-process composed of radiated cells.

Animal with the mantle almost entirely closed; pedal aperture and foot small; siphons united, partly or wholly retractile; branchiæ two on each side, elongated.

MYA, Linn., 1758.

Etym.—*Myax* (-axis), a mussel (Pliny). Gaper.

Distr.—3 sp. Northern seas. Fossil, 17 sp. Pliocene—; United States, Britain, Sicily,

Shell oblong, inequivalve, gaping at the ends; left valve smallest, with a large flattened cartilage-process; pallial sinus large. Most of the fossil "Myas" have an external ligament, and are related either to *Panopæa* or *Pholadomya*.

Animal with a small straight linguiform foot; siphons combined, covered with epidermis, partially retractile; orifices fringed, the branchial opening with an inner series of large tentacular filaments; gills not prolonged into the siphon; palpi elongated; free.

The Myas frequent soft bottoms, especially the sandy and gravelly mud of river-mouths; they range from low-water to 25 fathoms, rarely to 100 or 145 fathoms. *M. arenaria* (cvi, 19, 20) burrows a foot deep; this species and *M. truncata* (cvi, 18) are found throughout the northern and Arctic seas, from Ochotsk and Sitka to the Russian Icy-sea, the Baltic, British coast and northern United States; in the Mediterranean they are only found fossil. They are eaten in Zetland and North America, and are excellent articles of food. In Greenland they are sought after by the walrus, the Arctic fox, and birds. (*O. Fabricius.*)

PLATYODON, Conrad, 1837.

Distr.—*P. cancellata*, Conr. (cvi, 28). California.

Shell ventricose, with concentric, undulating striæ, and a small groove from the apex to the ventral margin; posterior side short, radiately striated, spoon-shaped cardinal process dilated and biemarginated. Siphonal orifices furnished with four valvular testaceous appendages, which close them.

TUGONIA, Gray, 1842.

Syn.—Le Tugon, Adanson.

Distr.—6 sp. West Coast of Africa. Fossil. Miocene; Dax, and the Morea. *T. anatina*, Gmel. (cvi, 21, 22).

Shell equivalve, globular or suboval, very inequilateral, widely gaping posteriorly; a spoon-shaped process and small cardinal tooth in each valve; ligament double, external and internal; pallial impression very short and simply arcuated.

Siphon very short, truncated, scarcely extending beyond the valves. Lives in indurated clay at the mouths of rivers, in Senegal.

FAMILY CORBULIDÆ.

Shell small, inequivalve, thick, gaping in front; hinge consisting of a single recurved tooth in one valve, received into a fosset or notch in the other.

Animal unsymmetrical; mantle closed except in front, the narrow opening dentate; siphons united, short, fringed. Living in the sand or mud on the seashore or in estuaries.

CORBULA, Bruguière.

Etym.—*Corbula*, a little basket.

Syn.—Erodina, Daud. (= Pacyodon, Beck.) Agina, Turt.

Distr.—73 sp. United States, Norway, Britain, Mediterranean, West Africa, China. Inhabits sandy bottoms; lower laminarian zone—80 fathoms. Fossil, 120 sp. Inferior Oolite—; Europe, India. Laramie—; United States. *C. Mediterranea*, Costa (cv, 93). *C. sulcata*, Brug. (cv, 94).

Shell thick, inequivalve, gibbose, closed, produced posteriorly; right valve with a prominent tooth in front of the cartilage-pit; left valve smaller, with a projecting cartilage-process; pallial sinus slight; pedal scars distinct from the adductor impressions.

Animal with very short, united siphons; orifices fringed; anal valve tubular; foot thick and pointed; palpi moderate; gills two on each side, obscurely striated.

TÆNIODON, Dunker, 1851. Shell ovately elongated; subequilateral, smooth, equivalve, and apparently closed, right valve with a cardinal tooth under the umbo extending forwards, left valve with a distinct marginal cartilage-pit behind the beak. Type, *T. ellipticus*, from liassic beds near Halberstadt (Germany). The ligament was partially external, partly internal, the valves not gaping.

ANISORHYNCHUS, Conrad. Shell nearly or quite equivalve, transversely pyriform, the posterior side being rostrate; beaks nearly equal, and distinctly incurved. Hinge, muscular and pallial impressions as in *Corbula*, except that the cardinal tooth is furrowed.

C. pyriformis, Meek. Associated with fresh- and brackish-water types.

PACHYODON, Gabb, 1868. (*Anisothyris*, Conr.) *P. obliqua*, Gabb (cvii, 33–35). Associated with marine and estuary types.

BOTHROCORBULA, Gabb, 1872. Differs from the typical *Corbula* in having a deep lunular pit under the beaks, penetrating and almost passing through the hinge-plate. *C. viminea*, Guppy (cvii, 36, 37).

PTEROMYA, Moore. Resembles *Corbula*, but thin; smooth or concentrically striated. *Pt. Crowcombei*, Moore. Rhætic beds, at Beer-Crowcombe.

HIMELLA, H. Adams, 1860. Shell thin, with the left valve larger than the right one, not gaping; hinge of the right valve with an indistinct tooth fitting into a pit in the left valve; cartilage internal, lying in both valves in an almost horizontally extending process; an external ligament is besides present; pallial sinus scarcely noticeable. Based on *H. fluviatilis*, Maranon Riv.

POTAMOMYA, J. Sowerby, 1839. (Azara, d'Orbigny, 1839.) *P. gregaria*. Eocene; Isle of Wight. Cartilage-process broad and spatulate, received between two obscure teeth in the right valve. The estuary *Corbulæ* differ very little from the marine species. *C. labiata* lives buried in the mud of the River Plata, but not above Buenos Ayres, and consequently in water which is very little influenced by the superficial ebb of the river. The same species is found in banks widely dispersed over the Pampas near San Pedro, and many places in the Argentine Republic, five yards above the River Parana. (Darwin.) *C. erodina*, Lam. (cvi, 23-25).

CORBULAMELLA, Meek and Worthen, 1857. Shell subtriangular, subglobose, inequivalve, the right valve being more ventricose than the left; beaks nearly central; hinge with one cardinal tooth in each valve, apparently very similarly arranged in position to that of *Corbula*, but the existence of an internal cartilage has not as yet been satisfactorily proved; anterior muscular impression rather indistinct, posterior on a special raised or projecting plate; pallial impression scarcely sinuated posteriorly. *C. gregaria*, M. and H. (cv, 95). Cretaceous; Nebraska.

PLECTODON, Carpenter, 1865.

Distr.—*P. scaber*, Carp. Catalina Isl., Cal.

Shell thin, rough, rostrate; dorsal margin twisted within under the umbones, forming the cardinal tooth; lateral teeth long, laminated; cartilage-pit minute, concealed under the umbones; posterior lateral tooth contiguous; pallial sinus small.

Has the aspect of *Theora*, and appears allied to *Næra*. It is probable that the cartilage was strengthened by an ossicle. The great peculiarity is the twisting-in of the dorsal margin, which ascends the umbo in a very loose spiral.

SPHENIA, Turton, 1822.

Distr.—4 sp. Britain, W. Coast of N. Am., Red Sea. Bur-

rowing in oyster-shells and limestone, in 10–25 fathoms. Fossil, 20 sp. Tertiary; Europe. *S. Binghami*, Turton (cv, 96).

Shell oblong; right valve with a curved, conic tooth in front of the oblique, subtrigonal cartilage-pit.

Animal with long, thick, united siphons, fringed at the end, anal valve conspicuous; foot finger-like, with a byssal groove. The prolonged siphons and the short digitiform byssiferous foot fairly distinguish the animals of this genus from those of *Corbula*. The hinge is occasionally very similar in both. As a rule the teeth in *Sphenia* become obsolete with age.

POROMYA, Forbes, 1843.

Etym.—Passing into the genus *Mya*.

Syn.—*Eucharis*; Recluz, 1850. *Embla*, Lovèn, 1846. *Cumingia parthenopœa*, Tiberi. ? *Basterotia*, Mayer.

Distr.—10 sp. Britain, Scandinavia, Mediterranean, Tropical America. Fossil, 13 sp. Cretaceous, Eocene; France, Germany, England, United States. *P. granulata*, Nyst. (cv, 97). *P. quadrata*, Hinds (cvi, 26).

Animal with unequal siphons, clothed with numerous filaments, foot narrow and slender.

Shell suborbicular, subequivalve, and inequilateral, thin, transparent, slightly nacreous within; valves closed, surface granulated; teeth, in right valve a short but strong cardinal, and in the left a minute triangular cardinal and a ridge-like lateral on the posterior side.

PLEURODESMA, Hörnes, 1859.

Distr.—*Pl. Mayeri*, Hörnes (cv, 98, 99). Tertiary; Europe.

Shell oblong or quadrangular, equivalve, closed on both sides, one large cardinal tooth in each valve, and a long groove extending along the dorsal margin of the shell for the reception of the cartilage; there is no indication of the presence of a ligament. This genus has been proposed for a tertiary shell, *Pl. Mayeri*, agreeing in general form with *Eucharis*, but differing widely in the form of the hinge.

CORBURELLA, Lycett.

Distr.—*C. curtansata*, Phil. Jurassic; England.

"Shell equivalve, thin, inflated, posteriorly attenuated and gaping, anteriorly rounded, hinge with a small, depressed sub-conical tooth in each valve, and extended, slightly thickened, laminar plate forming a kind of an anterior lateral tooth or process." Ligament and pallial sinus are not noticed, nor are they perceptible in the figure. In general form is near *Neæra*, but the tooth in each valve would recall *Eucharis*. Whether the anterior laminar process occurs in both valves and whether it is

for the purpose of supporting the cartilage, which seems likely, has yet to be satisfactorily determined.

SPHENIOPSIS, Sandberger, 1863.

Distr.—*S. scalaris*, Braun. Tertiary; Germany (cv, 1–3).

Shell subtrigonal, compressed, equivalve, posteriorly rostrate and slightly gaping; hinge of right valve with an anterior cardinal tooth, and a deep cartilage-pit behind it, a long laminar tooth runs along the areal margin; left valve edentulous, only provided with a cartilage-pit; pallial sinus deep.

NEÆRA, Gray, 1834.

Etym.—*Neæra*, a Roman lady's name.

Syn.—*Cuspidaria*, Nardo, 1840. *Sphena*, d'Orb., 1846.

Distr.—22 sp. Norway, Britain, Mediterranean, Canaries, Madeira, China, Moluccas, New Guinea, Chili; from 12–200 fathoms. Fossil, 14 sp. Oolite—; Britain, Belgium, Italy. *N. ornaticissima*, Orb. (cv, 4, 5).

Shell globular, attenuated, and gaping behind; right valve a little the smallest; umbones strengthened internally by a rib on the posterior side; cartilage-process spatulate, in each valve (furnished with a movable ossicle—Deshayes), with an obsolete tooth in front, and a posterior lateral tooth; pallial sinus very shallow.

Animal with the mantle closed; foot lanceolate; siphons short, united, branchial largest, anal with a membranous valve, both with a few long, lateral cirri.

Placed by Messrs. Adams in the *Anatinidæ*, though judging from the form of the shell, being in many respects similar to that of *Corbula*, and also from the form of the small foot and the short siphons of the animal, there can be little doubt that Deshayes' classification near *Sphænia*, *Corbula*, etc., is the more correct one. Almost the only character which some species of the genus have in common with the *Anatinidæ* is the presence of a small ossicle at the cartilage, but as all the *Anatinidæ* do not possess the same, its presence cannot be regarded as an exclusive character of that family.

RHINOMYA, A. Ad., 1864. For those forms having the surface of the shells lamellar, like *Neæra* proper, but possessing a small triangular cartilage-pit, and two lateral teeth in the right valve. *N. Philippinensis*, Hinds.

CARDIOMYA, A. Ad., 1864. Species with the surface radiately ribbed. *N. Gouldiana*, Hinds.

CORBULOMYA, Nyst., 1846.

Etym.—*Corbula* and *Mya*.

Distr.—3 sp. Mediterranean. Fossil, 7 sp. Eocene; France, Belgium, England. *C. antiqua*, Desh. (cvii, 38).

Shell oval, transverse, depressed, closed, inequivalve, subinequilateral; right valve the larger, with one pyramidal tooth, and a narrow and deep socket; left valve with two unequal teeth separated by a large socket. Ligament internal, pallial impressions simple, slightly inflected posteriorly.

Animal with the mantle united behind, margins of the mantle with duplicate foliaceous tentacles; foot compressed, triangular; siphons short, united at the base, the incurrent tube the larger and more elongated, the opening of which is surrounded by arborescent tentacles.

DORSOMYA, Ryckholt, 1852. The shell resembles *Corbulomya* in shape, but the knowledge of the hinge is necessary for its correct generic determination. Carboniferous; Belgium. *D. dorsata*.

CRYPTOMYA, Conrad, 1848.

Distr.—8 sp. California, Australia, Philippines. *C. Philippinarum*, A. Ad. (cvi, 27).

Shell inequilateral, transverse, oblong, gaping behind; valves with radiating, sometimes crossed by concentric striæ; right valve with a lamellar tooth, left valve with a broad fosset; ligament internal; pallial impression with a small sinus.

Siphons short; not covered as in *Mya* with a coriaceous epidermis.

FAMILY ANATINIDÆ.

Shell often inequivalve, thin; interior nacreous; surface granular; ligament external, thin; cartilage internal, placed in corresponding pits and usually furnished with a free ossicle; muscular impressions faint, the anterior elongated; pallial line usually sinuated.

Animal with mantle-margins united; siphons long, more or less united, fringed; gills mostly single on each side, the outer lamina prolonged dorsally beyond the line of attachment.

Pholadomya and its fossil allies have an external ligament only; no ossicle. The external surface of these shells is often rough with large calcareous cells, sometimes ranged in lines, and covered by the epidermis; the outer layer consists of polygonal cells, more or less sharply defined; the inner layer is nacreous.

The most important distinctions of the shells are their thin pearly structure and usually edentulous hinge. These at least are almost the only characters upon which we can depend in the determination of fossil species. The shells are generally inequilateral, but sometimes the anterior, sometimes the posterior side is the longer, and the latter usually has a wide gap at the end.

There is a large amount of variation in the form of the animals, but they all have the mantle-margins united, with an opening at the antero-inferior side for the protrusion of a small

digitiform foot; the siphons are more or less prolonged, united in their entire length or only at the base, and the united portion of these siphons is almost invariably covered with an extension of the shell-epidermis. There is also a small opening in the mantle below, at the base of the siphons. The gills are thin and in many cases (though not invariably) single. The palpi are usually long and narrow.

There is scarcely any other family of Pelecypoda so important to the palæontologist, being represented throughout the strata from the oldest sedimentary deposits. The species living at the present time may be said to be only the remnants of the group; they are distributed all over the world, but they are nowhere very numerous, and some of them belong to the rarest yet known shells. Their maximum of development appears to have been during the Jurassic period.

(*Pandoræ*.)

PANDORA (Solander), Bruguière, 1792.

Etym.—*Pandora*, the Grecian Eve.

Syn.—*Pandorella*, Conrad.

Distr.—24 sp. United States, Spitzbergen, Jersey, Canaries, India, New Zealand, Philippines, Panama; 4–110 fathoms, burrowing in sand and mud. Fossil, 14 sp, Eocene—; United States, Britain. *P. oblonga*, Sowb. (cviii, 48). *P. inæquivalvis*, Linn. (cviii, 49).

Shell inequivalve, thin, pearly inside; valves close, attenuated behind; right valve flat, with a diverging ridge and cartilage-furrows; left valve convex, with two diverging grooves at the hinge; usually no ossicle; pallial line slightly sinuated. Outer layer of regular vertical, prismatic cells.

Animal with mantle closed, except a small opening for the narrow, tongue-shaped foot; siphons very short, united nearly throughout, ends diverging, fringed; palpi triangular, narrow; gills plaited, one on each side, with a narrow dorsal border.

KENNERLIA, Carp., 1864. Under this name are separated a few species, which still more resemble *Myodora*, than the true *Pandoræ*. They all have a thin hinge-ossicle, and the typical species have radiating ribs on the right valve. *P. bicarinata*, Carp.

CELODON, Carp., 1864. The form of the shell is similar to that of *Pandora*; each valve with two hinge-teeth directed towards the anterior adductor muscle, and in the left one they are connected by a thin lamina; no ossicle or pallial sinus. *P. Ceylonica*, Sowb. (cviii, 47).

CLIDIOPHORA, Carp., 1864. Similar in form to the last; right valve rather tumid, with three hinge-teeth; the posterior one elongated; left valve often with two teeth; ossicle present,

pallial line simple. All the species at present known are from North American seas. *P. claviculata*, Carp.

MYODORA Gray, 1840.

Distr.—12 sp. New Zealand, New South Wales, Philippines. *M. striata*, Quoy (cviii, 50).

Shell trigonal, rounded in front, attenuated and truncated behind; right valve convex, left flat; interior pearly; cartilage narrow, triangular, between two tooth-like ridges in the left valve, with a free sickle-shaped ossicle; pallial line sinuated; structure like *Anatina*; outer cells large, rather prismatic.

MYOCHAMA, Stutchbury, 1830.

Distr.—5 sp. New South Wales; attached to *Crassatella* and *Trigonia*, in 8 fathoms water; the fry (as indicated by the umbones) is free, regular, and *Myodora*-shaped. *M. anomioides*, Stutchb. (cviii, 51–53). *M. Keppelliana*, A. Ad. (cviii, 54).

Shell inequivalve, attached by the dextral valve and modified by the form of the surface of attachment; posterior side attenuated; left valve gibbose; cartilage internal, between two tooth-like projections in each valve, and furnished with a movable ossicle; anterior muscular impression curved, posterior rounded, pallial sinus small.

Animal with mantle-lobes united; pedal opening and siphon surrounded by separate areas; siphons distinct, unequal, small, slightly fringed; a minute fourth orifice close to the base of the branchial siphon; visceral mass large, foot small and conical; mouth rather large, upper lip hood-like; palpi tapering, few-plaited; gills one on each side, triangular, plaited, divided by an oblique line into two portions; excurrent channels four, two at the base of the gills and two below the dorsal laminae.

(*Thraciæ*.)

ASTHENOTHÆRUS, Carpenter, 1864.

Distr.—*A. villosior*, Carp. Cape St. Lucas, L. Cal.

Shell like *Thracia*, hinge without teeth, spongy cartilage situated in a pit under the umbones.

THRACIA (Leach), Blainville, 1824.

Syn.—*Odoncinetus*, Costa. *Cinctodonta*, Herm. *Corymya*, Agassiz.

Distr.—27 sp. Greenland, United States, Norway, Britain, Mediterranean, Canaries, China, Sooloo; 4–110 fathoms. Fossil, 36 sp. (Trias?) Lower Oolite—; United States, Australia, Europe. *T. pubescens*, Pult. (cviii, 55). *T. plicata*, Desh. (cviii, 56).

Shell oblong, nearly equivalve, slightly compressed, attenuated and gaping posteriorly, smooth, or minutely scabrous; cartilage-processes thick, not prominent, with a crescentic ossicle; pallial sinus shallow. Outer shell-layer composed of distinct, nucleated cells.

Animal with the mantle closed; foot linguiform; siphons rather long, separate, with fringed orifices; gills single, thick, plaited; palpi narrow, pointed.

T. concentrica and *T. distorta*, Mont., are found in the crevices of rocks, and burrows of *Saxicava*; they have been mistaken for boring-shells.

RUPICOLA, Bellevue, 1802. (*Ixartia*, Leach, 1852. *Ligula*, Recluz.) Shell irregularly suboval, hinge with a vertical cartilage-process; pallial sinus small, obtuse, triangular. Siphonal orifices simple. *T. concentrica*, Bellevue.

T. declivus, Recl., is the type of *Ligula*, which does not appear to differ essentially from *Rupicola*.

CALCARA, Recluz, 1868. (*Periplomya*, Conr.) Form typical of the *Thracia*, nearly equilateral, equivalve, hinge with a spoon-shaped cartilage-process in each valve directed anteriorly, pallial sinus deep. This name has been proposed for the fossil *Anat. oblonga*, Philippi.

PERIPLOMA, Schumacher, 1817.

Syn.—*Anatina* (partim), Lam. *Bontia*, Leach, Brown, 1844. *Galaxura*, Leach.

Distr.—12 sp. U. S., W. Indies, Panama, So. America. *P. inæquivalvis*, Schum. (cviii, 57-59).

Shell oval, very inequivalve, inequilateral, slightly nacreous; left valve deepest; posterior side very short and contracted; hinge with a narrow, oblique, spoon-shaped process in each valve, and a small triangular ossicle; an internal rib proceeds from under the hinge to the posterior margin; muscular impressions unequal, the anterior long and narrow, the posterior small, semi-lunar; pallial impression marginal. Siphons long and slender, separate.

COCHLODESMA, Couthouy. Oblong, compressed, thin, slightly inequivalve; umbones fissured; cartilage-processes prominent, ossicle minute; pallial sinus deep. Animal with a broad, compressed foot; siphons long, slender, divided throughout; gills one on each side, deeply plaited, divided by an oblique furrow into two parts, the dorsal portion being narrower, composed of a single lamina only, and attached by its whole inner surface. 2 sp. U. S., Britain, Mediterranean. Fossil. Pliocene; Sicily. *T. prætenuis*, Mont. (cviii, 60). *T. Leana*, Couth. (cviii, 61). Hardly distinct from the typical group.

PELOPIA, H. Adams, 1868. Shell oval, inequivalve, closed on

both ends, surface scabrous; hinge with a long, horizontal excavated cartilage-process; ligament placed in a deep groove. *Pel. brevifrons*, H. Ads. (cviii, 62, 63), is the type of the group, which differs from *Periploma* by the want of an internal rib below the cartilage-process and by not having the beaks fissured.

ALICIA, Angas, 1867.

Distr.—2 sp. Port Jackson, Australia. *A. angustata*, Angas (cviii, 64, 65).

Shell inequivalve, resembling a small *Thracia*, but the posterior portion is much smaller than the anterior, internally subnacreous; beaks entire; hinge composed of a posterior callus in the right valve fitting in a cavity in the left one, and an anterior marginal tooth or ridge; cartilage internal under the umbones, covered by a large triangular ossicle; pallial line deeply sinuated.

LYONSIA, Turton, 1822.

Syn.—Magdala, Leach, 1827. Hyatella, Brown. Pandorina, Scacchi.

Distr.—18 sp. Greenland, North Sea, Norway, West Indies, Madeira, India, Borneo, Philippines, Peru. Fossil? Miocene—; Europe. (100 sp. Lower Silurian—. D'Orbigny.)

Shell nearly equivalve, left valve largest, thin, subnacreous, close, truncated posteriorly; cartilage-plates oblique, covered by an oblong ossicle; pallial sinus obscure, angular. Structure intermediate between Pandora and Anatina; outer layer composed of definite polygonal cells.

Animal with the mantle closed; foot tongue-shaped, grooved, byssiferous; siphons very short, united nearly throughout, fringed; lips large, palpi narrow, triangular.

L. Norvegica (cviii, 66) ranges from Norway to the sea of Ochotsk; in 15–80 fathoms.

LYONIELLA, Sars, 1868. *L. abyssicola*, Sars.

SOULEYETIA, Recluz. Shell inequilateral, spoon-like process directed backwards.

? ENTODESMA, Phil. Shell thin, Saxicava-shaped, slightly inequivalve and gaping, covered with thick epidermis; hinge edentulous; each valve with a semicircular process containing the cartilage. Ossicle and pallial impression not observed. *E. Chilensis*, Phil. (cviii, 67).

(*Anatinæ*.)

Mostly fossil. The classification is very unsatisfactorily known. Some forms are tumid and cordate, like the recent *Mytilimeria* or the fossil *Cercomyæ*, and others are elongated and considerably compressed, as the typical *Anatinæ* and the

fossil Corimya. But among the enormous number of known Pholadomya, we meet similar variations in one and the same genus.

MYTILIMERIA, Conrad, 1837.

Distr.—2 sp. *M. Nuttalli*, Conr. (cviii, 68).

Shell rounded-oval, more or less ventricose, equivalve, fragile, covered by a thin caducous epidermis; beaks subspiral; hinge without teeth, but formed of small linear excavations under the beaks to receive the ligament, which contains a small ossicle; muscular impressions small; pallial impression with an obtuse sinus.

Animal gregarious, forming a nest.

EDMONDIA, Koninck, 1842.

Distr.—Fossil, 4 sp. Carb.—Permian; Europe. *E. unioniformis*, Phil. (cvii, 39).

Shell oblong, equivalve, thin, concentrically striated, close; umbones anterior; ligamental grooves narrow, external; hinge-line thin, edentulous, furnished with large oblique cartilage-plates, placed beneath the umbones, and leaving space for an ossicle? or the plate may be equivalent to the subumbonal blade in Pholas; pallial line simple?

CARDIOMORPHA, Koninck, 1842.

Distr.—Fossil, 38 sp. Lower Silurian—Carb.; N. America, Europe. *C. excentrica*, Agass. (cvii, 40).

Type, *C. oblonga* (Isocardia), Sowerby (not Koninck). Carboniferous.

Shell Isocardia-shaped, smooth or concentrically furrowed, umbones prominent, hinge edentulous; hinge-margin with a narrow ligamental furrow, and an obscure internal cartilage-groove.

CEROMYA, Agassiz, 1842.

Etym.—*Keraos*, horned; *mya*, mussel.

Distr.—Fossil, 14 sp. Inferior Oolite, Greensand; Europe. *C. Aalensis*, Quenst. (cvii, 41, 42).

Shell Isocardia-shaped, slightly inequivalve? very thin, granulated, often excentrically furrowed; ligament external; hinge edentulous; right valve with an internal lamina behind the umbo; pallial line scarcely sinuated?

The Ceromya are principally characterized by their tumid, thin and concentrically laminated shell, distant beaks, and the oblique furrows which are externally traceable. Chenu unites this to Cardiomorpha, but in that genus there does not appear to be any such arrangement for the attachment of an internal ligament (similar to that of Lyonsia); there is along the raised

upper margin no trace of a special furrow, and the beaks are closely approximate to each other.

GRESSLYA, Agassiz, 1842.

Distr.—50 sp. Lias, Jura; Europe. *G. zonata*, Agass. (cvii, 43).

Shell oval, rather compressed; umbones anterior, incurved, not prominent; valves thin, close, smooth or concentrically furrowed; pallial sinus deep. The lamina within the posterior hinge-margin of the right valve produces a furrow in the casts, which are more common than specimens retaining the shell.

ALLORISMA, King, 1844.

Syn.—*Cercomyopsis*, Meek.

Distr.—Devon., Carboniferous. *A. sulcata*, Flem. (cvii, 44).

Shell transversely elongated, very thin, elliptical, equivalve, very inequilateral; each valve with an elongated ligamentary support; hinge without teeth; valves concentrically plicate, in some species radiately punctate, in others the very small punctations are distributed without order.

MYACITES (Schlotheim), Bronn.

Distr.—Fossil, 50 sp. Triassic—Lower Chalk; United States, Europe, South Africa.

Shell oblong, ventricose, gaping, thin, often concentrically furrowed; umbones anterior; surface granulated; ligament external; hinge with an obscure tooth or edentulous; muscular impressions faint; pallial line deeply sinuated.

PACHYMYA, Sowb., 1826. Shell transversely elongated, modioliform, equivalve, thick; beaks subterminal. Cretaceous.

HOMOMYA, Agassiz, 1842. Shell very thin, transverse, oval, ventricose, inequilateral, gaping at the extremities; hinge without teeth; beaks thick, rounded, a little curved. Jurassic.

PLEUROMYA, Agassiz, 1842. (*Anoplomya*, Krauss.) Shell elongated or ovoid, very thin, nearly papyraceous, concentrically furrowed; beaks large, swollen, anterior, recurved in front, contiguous; pallial impression with a large, profound sinus, rarely distinct. D'Orbigny has found cardinal teeth in well-preserved specimens, and refers *Pleuromya* to *Panopæa*. Several sp. Liassic and Jurassic. *P. tenuistriata*, Agass.

MYOPSIS, Agassiz, 1845. Shell moderate or large sized, covered with linear points forming radiating lines, more or less gaping at both extremities; a cardinal tooth in each valve; beaks more or less anterior, sometimes even marginal; pallial impression with a profound sinus; muscular impressions indistinct. 25 sp. Jurassic and Cretaceous; Europe. *M. la'a*, Agass. (cvii, 45).

ARCOMYA, Agassiz, 1842. Shell very thin, much elongated transversely, sometimes compressed, sometimes more or less

cylindrical, gaping at both extremities, greatly posteriorly; beaks small, narrow, pointed, nearly contiguous, not elevated and but little curved; anterior muscular impressions oval or pyriform, posterior rounded; pallial impression indistinct. 12 sp. Liassic and Jurassic. Europe. *M. oblonga*, Agass. (cviii, 69).

MACTROMYA, Agassiz, 1842. (Plectomya, Lorient.) Shell swollen or globular, very thin, striate; hinge without teeth—at least none are visible on the internal casts; an internal rib proceeds from before the beaks obliquely to the anterior margin. Cretaceous and Jurassic; Europe. *M. rugosa*, Agass. (cvii, 46).

SEDGWICKIA, M'Coy, 1844.

Distr.—*S. attenuata*, M'Coy. Carb.; Europe. Sil.; N. Y.

Shell elongated, inequilateral, anteriorly rounded and shorter, posteriorly subtruncated, moderately tumid, with incurved beaks, anterior half of the surface ornamented with concentric sulcations, becoming obsolete posteriorly, hinge edentulous.

PYRENOMÆUS, Hall, 1852. Elongated, inequilateral, anteriorly rounded, posteriorly attenuated and produced, concentrically striate-sulcated on the surface; beaks tumescent, anterior muscular impression deep, subanterior (posterior unknown); hinge apparently without teeth?

P. cuneatus, Hall (cxx, 15). Clinton group (Middle Silurian) of North America. Perhaps belongs in Nuculidæ.

LEPTODOMUS, M'Coy, 1844. Shell oblong, somewhat trapezoid, tumid, very thin, anteriorly rounded, beaks subanterior, posteriorly subtruncate and gaping, concentrically sulcated; beaks incurved, with a somewhat excavated lunule below; hinge without teeth, the posterior hinge-line more or less straight, muscular and pallial impressions faint. *L. fragilis*, M'Coy. The species are all palæozoic; those with a median sulcus extending from the beaks to the ventral edge seem to be more correctly referable to Grammysia; the typical forms greatly resemble some Cypriocardia, but are readily distinguished from them by their thin shells.

TYLERIA, H. and A. Adams, 1854.

Distr.—*T. fragilis*, H. and A. Ad. (cviii, 70). Mazatlan.

Shell oblong, rounded in front, gaping behind, covered by a very slight epidermis; valves thin, nearly membranaceous; cartilage inserted in a spoon-shaped hollow; interior of shell with a layer of carbonate of lime between the spoon-shaped hollow and the anterior edge; pallial line with a profound sinus.

ANATINA, Lamarck, 1809.

Etym.—*Anatinus*, pertaining to a duck. Lantern-shell.

Syn.—Laternula, Bolten, 1798. Auriscalpium, Muhlf., 1811. Rhynchomya, Agass.

Distr.—37 sp. India, Philippines, New Zealand, Japan, United States. Fossil, 50 sp. Devonian?—Oolite—; United States, Europe. *A. truncata*, Lam. (cviii, 71).

Shell oblong, ventricose, subequivalve, thin and translucent, posterior side attenuated and gaping; umbones fissured, directed backwards, supported internally by an oblique plate; hinge with a spoon-shaped cartilage-process in each valve, furnished in front with a transverse ossicle; pallial sinus wide and shallow.

Animal with a closed mantle and long united siphons, clothed with wrinkled epidermis; gills one on each side, thick, deeply plaited; palpi very long and narrow; pedal opening minute, foot very small, compressed.

PLATYMYA, Agassiz, 1838. Some of the species of this fossil group are more compressed than the recent Anatinae, but it can scarcely be considered generically distinct. *A. rostrata*, Agass.

CERCOMYA, Agassiz, 1842. Shell elongated, compressed; beaks fissured; posterior slope frequently angulated. Jurassic, Cretaceous. *A. gracilis*, of Australia, is a recent species. *A. striata*, Agassiz (cviii, 72). Jurassic.

PLECTOMYA, Loriol, 1868. Shell ovately elongated, equivalve, beaks subcentral, a strong oblique rib posterior to them; hinge edentulous; ligament external. Based on a well-known Jurassic fossil, the *Tellina rugosa* of Römer. Appears to be scarcely distinguishable, however, from Platymya.

PERIPLOMYA, Conrad, 1870. (Leptomya, Conrad [not A. Adams], 1867. Plicomya, Stoliczka, 1870.) Shell oblong, perlaceous, gaping anteriorly; hinge with a spoon-shaped cartilage-process, forming an oblique callosity, which extends to the cardinal margin; an obsolete rib and fissure run obliquely from the anterior side of the beak. The genus is evidently closely allied to Anatina, from which it chiefly differs by the rib and fissure anterior to the beak. Based on a North American cretaceous species. *P. applicata*, Conrad.

ANATIMYA, Conrad, 1860. Shell oblong, like an Anatina, anterior side with concentric sulci, posterior with radiating ribs. Only American and cretaceous. *A. anteradiata*, Conr. (cviii, 73).

ANTHRACOMYA, Salter, 1861.

Etym.—*Anthrax*, coal, and *mya*, a generic name.

Syn.—Naiadites, Dawson.

Distr.—9 sp. Coal-measures, associated with marine animals. Great Britain, Nova Scotia. *A. Adamsi*, Salter.

Shell thin, equivalve, the right valve rather larger; valves close, oblong, wider behind, where there is a blunt siphonal ridge; rounded anteriorly, with a byssal sinus on the anterior ventral edge. Beaks small, anterior, and slightly prominent,

with an obscure lunette; posterior hinge-line with a narrow interior ridge; ligament external. Epidermis strongly wrinkled.

Animal unknown; probably had a closed mantle and respiratory siphons.

CYATHODONTA, Conrad, 1849.

Distr.—4 sp. China, L. Cal., Honduras. *C. granulosa*, Ads. and Reeve (cviii, 74). = *C. ...*

Shell like *Anatina* in form; "hinge with a broad, not very projecting fosset, which is carinated near the margin; muscular impressions rounded, indistinct; pallial impression with a large, rounded sinus."

GONIOMYA, Agassiz, 1838.

Syn.—*Lysianassa*, Munst., 1838.

Distr.—Cretaceous and Jurassic. *G. Duboisi*, Agass. (cviii, 75).

Shell oblong, rather compressed, thin, surface marked about the middle of the flanks with angularly bent striae or ribs; hinge without teeth; a slight incision below the beaks, and slightly thickened nymphæ beyond the same for the attachment of a ligament are present.

CHÆNOMYA, Meek, 1865.

Syn.—*Anoplomya*, Krauss.

Distr.—Cretaceous, Jurassic. *C. Cooperi*, Meek (cix, 84).

Shell oblong, equivalve, inequilateral, thin, concentrically striated or ribbed, with an oblique process below the beaks of each valve, probably supporting an internal cartilage; nymphæ prominent for the attachment of an external ligament; sinus very deep and usually angular.

Terquem has sufficiently proved that this a good genus, and must be kept separate from *Homomya*, *Myacites* and *Panopæa*, which it externally greatly resembles.

Shell much like *Anthracomya*, of thin structure, more or less compressed, posteriorly gaping.

PHOLADOMYA, G. Sowerby.

Syn.—*Procardia*, Meek.

Distr.—2 sp. West Indies, off Rhode Island. *P. candida*, Sowb. (cviii, 76, 77). Fossil, 160 sp. Lias—; United States, Europe, Algeria, Thibet. *P. exaltata*, Agass. (cix, 85). *P. glabra*, Agass. (cix, 86).

Shell oblong, equivalve, ventricose, gaping behind; thin and translucent, ornamented with radiating ribs on the sides; ligament external; hinge with one obscure tooth in each valve; pallial sinus large.

Animal with a single gill on each side, thick, finely plaited, grooved along its free border, the outer lamina prolonged dorsally; mantle with a fourth (ventral) orifice.—OWEN.

Pholadomya was largely represented in the Jurassic, decreased considerably in the tertiary period, and is now nearly extinct.

CYMELLA, Meek, 1864. Shell small, subequilateral, ovate, with numerous well-defined concentric undulations, crossed on the middle of the valves by a few impressed lines, not marked in the depression between the ridges. *P. undata*, M. and H. Cretaceous; Texas.

LIOPISTHA, Meek. Shell transversely subovate, ornamented, excepting on the posterior dorsal portions of the valves, by regular, simple, well-defined, sometimes subcrenate, radiating costæ. *P. elegantula*, Römer. Cretaceous; Texas. *P. frequens*, Zitt. (cix, 87).

PSILOMYA, Meek. Radiating striæ or ridges nearly or quite obsolete, the radiating rows of granules or spines, usually more distinct; sometimes with well-defined concentric furrows and ridges. *P. superba*, Stoliczka.

MACHOMYA, Lorient, 1868. Shell oblong, subcompressed, equivalve, strongly inequilateral, rather solid and with punctated surface; a strong, radiating rib issues from the umbones, and runs towards the anterior margin; ligament external, solid. The hinge is not known, but the form of the shell, with its strong external ligament, appears to form a passage to the *Panopæa*. *M. Dunkeri*, Orb. Jurassic.

MARGARITARIA, Conrad, 1862. Its peculiar muscular and pallial impressions should perhaps rank it as a genus. It has not been characterized. *P. abrupta*, Conrad. Miocene; Atlantic Slope, United States.

? *ACTINOMYA*, Ch. Mayer. Appears to = *Margaritaria*.

PALANATINA, Hall, 1869.

Distr.—*P. typa*, Hall. Fossil. Chemung Gr., New York.

Shell transversely elongate, very inequilateral, inequivalve, and gaping at the extremities; left valve the larger and most convex, with a subangular umbonal ridge, and a broad, shallow, anteromesial constriction passing obliquely from beak to base; the beak small and prominent; right valve much less convex, with a smaller beak and faint umbonal ridge and sinus; valves united by a small external ligament; hinge without lateral teeth, but provided with a small, hook-like process in each valve, just anterior to the beaks, which may have served the purpose of teeth, or more probably for the support of an internal cartilage; muscular impression very small and indistinct; the anterior scar rounded, situated just in front of the beak, and near the cardinal margin; the posterior scar somewhat larger, situated about one-third the distance from the beaks to the posterior extremity; pallial line not satisfactorily determined, but no evidence of a sinus has been detected; exterior surface marked by fine concentric striæ.

NEÆROMYA, Gabb, 1872.

Distr.—*N. quadrata*, Gabb (cviii, 78–80). Tertiary; West Indies.

Shell thin, translucent, in shape approaching *Pholadomya*, ends closed; hinge with a prominent tooth in the right valve, articulating behind a smaller similar one in the left valve; an anterior and posterior lateral tooth in each valve; mantle-margin without sinus.

This genus, in its thin character and minute hinge, is closely allied to *Pholadomya*, *Thetis*, and *Neæra*, but differs from all in the details of the hinge. *Neæra* has no cardinal tooth, but in its place a cartilage-pit in each valve; it has a single posterior tooth, while this genus has the anterior equally well-developed. In having corresponding teeth in both valves it differs from *Thetis*, while its well-specialized hinge and its closed ends distinguish it from *Pholadomya*.

OSTOMYA, Conrad, 1874.

Distr.—*O. papyria*, Conr. (cviii, 81, 82). Tertiary; Upper Amazon.

Shell thin, concentrically plicate; hinge with a spoon-shaped oblique fosset in the left valve, and a small tooth near the apex; right valve cartilage-fosset very oblique, almost parallel with the hinge-line.

TELLINOPSIS, Hall, 1869.

Syn.—*Tellinites*, M'Coy (part).

Distr.—*T. submarginata*, Conr. (cviii, 83). Fossil. Hamilton Group, New York.

Shell thin, fragile, general form of *Tellina*, with moderately convex valves, small subcentral beaks, having their apices directed backwards with a shallow posterior furrow; hinge apparently edentulous; ligament external, small; muscular impression very faint, situated near the cardinal extremity; palial line undetermined.

SANGUINOLITES, M'Coy, 1844.

Syn.—*Cypricardites*, Conr., 1841 (part).

Distr.—Carbon.; Eur. *S. discors*, M'Coy.

Very elongated, with subparallel upper and lower margins, rounded anteriorly, obliquely truncate posteriorly, with an oblique prominent ridge from the beaks to the postero-inferior margin, very inequilateral, beaks slightly prominent, close together, subanterior; anterior muscular impression oval, distinct, with a small groove above it, and both posteriorly bounded by a prominent ridge, posterior muscular scar faint; cardinal margin internally thickened the whole length, probably for the support of a ligament; surface concentrically (or

radiately ? sometimes partially) striated or sulcated. Only palæozoic species are referred to the genus ; some of them are in external form almost identical with *Pharella*, and it as yet remains to be shown whether there are in *Sanguinolites* any hinge-teeth or not. In the Brit. Pal. foss. (p. 276), M'Coy considers this genus apparently identical with King's *Allorisma*, which is very doubtful.

POMACRUS, Meek, 1871. Shell thin, more or less elongate-subtrapeziform, nearly or quite equivalve, either inequilateral or equilateral, the beaks being nearer the anterior or posterior end, or central, according to the species ; valves closed all around, and each with a well-defined keel or more obtuse ridge extending from the posterior side of the beaks to the posterior basal extremity ; anterior side attenuated and produced ; posterior margin wider (higher) than the other, and obliquely truncated ; dorsal margin sloping in front of the beaks, and more nearly horizontal and apparently without an escutcheon behind them ; ligament external or marginal, rather long ; surface with concentric lines and ridges, and sometimes obscure radiating markings on the umbonal region. Hinge, muscular, and pallial impressions unknown. *P. nasutus*, Meek. 2 sp. Carb. ; Missouri.

PYANOMYA, Miller, 1882.

Distr.—*P. gibbosa*, Miller (cxx, 9, 13). Hudson Riv. Group ; Cincinnati, Ohio.

Shell small, inequilateral, with thin, fragile, ventricose, edentulous valves, united by an external ligament ; no escutcheon.

GRAMMYSIA, de Verneuil, 1847.-

Distr.—Silur., Devon. ; N. Am., Eur. *G. pes-anseris*, Sandb. (cxx, 14). *G. ovata*, Sandb. (cxxi, 5).

Shell equivalve, inequilateral, transverse ; not gaping ; muscular impressions very unequal ; pallial line posteriorly rounded, bordering the large muscular impression so as to leave the latter two-thirds without it ; ligament exterior, prolonged, in a depression of the dorsal line ; surface with one or more oblique ribs, and several rounded concentric plications.

ORTHONOTA, Conrad, 1841.

Distr.—*O. undulata*, Conr. *O. contracta*, Conr. (cxxix, 13, 14). L. Silur. ; U. S.

Shell narrow, with subparallel upper and lower margins, very inequilateral, the beaks being subanterior and tumescent, lunula in front of the beaks somewhat excavated, very thin, surface posteriorly generally undulately striated, hinge apparently without teeth.

CUNEAMYA, Hall and Whitfield, 1875.

Distr.—*C. Miamiensis*, H. and W. (cxx, 6). Silurian; Ohio.

Thin, fragile, bivalve shells, with ventricose valves, and strong, prominent, incurved beaks; cardinal line straight or gently curved; hinge edentulous; valves united by an external ligament of greater or less extent, posterior to which the margins of the valves overlap each other to the extent of the cardinal line; margins of the valves inflected along the cardinal border, forming a narrow escutcheon posterior to the beaks, and anteriorly a well-defined lunule is situated below the beaks; adductor muscles, at least two, are anterior and posterior; pallial line simple.

ORTHODESMA, Hall and Whitfield, 1875.

Distr.—*O. recta*, H. and W. (cxx, 7). Hudson Riv. Gr.; Ohio.

More or less elongate, bivalve shells, having the hinge-line straight and generally extended posterior to the beaks, but contracted or bent beneath or anterior to them; hinge-plate apparently edentulous; valves united by an external ligament extending to a greater or less distance along the posterior cardinal margin. Posterior muscular scar elongate-ovate, anterior scar smaller, both faintly marked; pallial line simple. Shells thin, marked externally with irregular concentric plicæ.

ILIONIA, Billings, 1874.

Distr.—3 sp. Sil., Devon.; U. S. *I. sinuata*, Hall.

Shell (cast) irregularly ovate, compressed or sublenticular, one extremity larger than the other; beaks turned towards the larger end, which is therefore supposed to be anterior; a concave depression commences on the umbones and extends downwards to the posterior ventral margin; a large subovate muscular impression in the upper half of the posterior extremity; close under the beaks in front there appears to have been a short escutcheon; no teeth.

CLARKIA, Koninck, 1878.

Distr.—*C. Myiformis*, Dana. Carb.; N. S. Wales.

Shell elongated, equivalve, gaping at its anal extremity, rather thick, with growth-lines; ligament external; hinge thick, callous, with a small tooth in each valve immediately under the beak; interior surface smooth; adductor and pedal impressions separate, the first large, oval, but slightly marked, the last stronger and small; pallial line nearly simple, slight.

[RIBEIRIA, Sharpe, 1853.

Distr.—Fossil, 4 sp. L. Silurian; Portugal, Canada, England. Shell gaping at both ends; subovate, rounded in front, elon-

gated and rather attenuated behind; punctate-striate; casts of interior with a large umbonal impression (caused by a cartilage-plate, as in *Lyonsia*?) and a notch in front of it.

Mr. Billings describes in this genus, "beneath and in front of the umbo, a small aperture of a semicircular shape, which appears to be the entrance to a tubular passage running backwards over the transverse plate into the general cavity of the body." He regards it as a byssal orifice.

Mr. J. W. Salter referred this genus to the class Crustacea.]

(*Veneracea*.)

FAMILY MACTRIDÆ.

Shell equivalve, trigonal, close, or slightly gaping; ligament (cartilage) internal, sometimes external, contained in a deep triangular pit; epidermis thick; hinge with two diverging cardinal teeth, and usually with anterior and posterior laterals; pallial sinus short, rounded.

Animal with the mantle more or less open in front; siphonal tubes united, orifices fringed; foot compressed; gills not prolonged into the branchial siphon.

SUBFAMILY MACTRINÆ.

Shell oval or subtriangular, nearly close behind; lateral teeth distinct, lamellar, well-developed.

MACTRA, Linn., 1767.

Etyim.—*Mactra*, a kneading-trough.

Distr.—150 sp. All seas, especially within the tropics; —35 fathoms. Fossil, 30 sp. Lias—; United States, Europe, India. *M. turgida*, Gmel. (cix, 89-91).

Shell nearly equilateral; anterior hinge-tooth A-shaped, with sometimes a small laminar tooth close to it; lateral tooth doubled in the right valve.

Animal with the mantle open as far as the siphons, its margins fringed; siphons united, fringed with simple cirri, anal orifice with a tubular valve; foot large, linguiform, heeled; palpi triangular, long and pointed; outer gills shortest.

The *Mactras* inhabit sandy coasts, where they bury just beneath the surface; the foot can be stretched out considerably, and moved about like a finger; it is also used for leaping. They are eaten by the star-fishes and whelks, and in the Isle of Arran *M. subtruncata* is collected at low-water to feed pigs.—ALDER.

MACTRA (restricted). (*Trigonella* [Da Costa], Adams.) Cardinal teeth moderate; lateral teeth elongated, linear, subequal;

marginal ligament triangular, separated in the pit by a testaceous lamina; pallial sinus rounded.

SCHIZODESMA, Gray, 1837. Ligament not distinctly separate from the cartilage (the character does not appear to be very constant); pallial sinus angular. *M. Spengleri*, Gray (cix, 92-94).

HEMIMACTRA, Swains., 1840. (*Spisula* and *Standella*, Gray, 1849.) Shell trigonal; posterior slope more or less carinated; cardinal teeth moderate, laterals elongated; ligament triangular, submarginal, not separated by a testaceous lamella from the cardinal pit; pallial sinus small, rounded. *M. solidissima*, Chemn. (cix, 95). *M. triangula*, Brocc. (cix, 96).

MACTROMERIS, Conr. Not characterized. *M. ovalis*, Gould (cx, 22).

OXYPERAS, Mörch, 1853. Proposed for the more elongated triangular forms of Hemimactra, concentrically plicate-striate. *M. triangularis*, Lam. (cix, 97).

CYMBOPHORA, Gabb, 1869. Proposed for *Mactra Ashburnerii*, a cretaceous species. Form as in the typical *Mactra*, but the hinge is composed of a rather heavy hinge-plate, bearing a cartilage-pit, not sunk into its substance, as in other genera of the Mactridæ, but, as it were, built upon its surface; a small delicate spoon-shaped process laid obliquely under the beaks, its base being on or slightly above the level of the hinge-plate; in the right valve the cardinal tooth is single, very delicate, and nearly at a right-angle with the anterior wall of the cartilage-pit; in the left valve the tooth is A-shaped, entirely separated from the pit, very slender, and articulates between the tooth and the pit of the opposite side; the lateral teeth are large and very robust.

MULINIA, Gray, 1836.⁵³ Shell oval-trigonal, subangular on each slope; cardinal teeth strong, laterals short and simple; internal ligament in the cardinal pit; pallial sinus angular. *M. edulis*, King (cix, 98-100).

MACTRINULA, Gray, 1849.⁵³ (*Blainvillia*, Hupè, 1854.) Shell thin, trigonal, posterior slope shortest, angulated, cardinal teeth thin, the short laterals close to them; outer ligament separated from the cardinal pit by a testaceous lamella. *M. plicataria*, Linn. (cix, 1).

MACTRELLA, Gray, 1849.⁵³ Shell thin, triangular; cardinal teeth thin, lateral posterior tooth very short, rudimentary, and close to the cardinal tooth; marginal ligament triangular, separated from the cartilage-pit by a lamella; pallial sinus rounded, profound. *M. alata*, Spengl. (cix, 2-4).

HARVELLA, Gray, 1849.⁵³ Shell thin, trigonal, well rounded inferiorly, posterior slope very narrow, carinated, its margin nearly straight; surface concentrically plicate; cardinal teeth

thin, with the very thin, short lateral teeth closely approaching them; ligament separated from the cartilage-pit by a lamella; pallial sinus rounded. *M. elegans*, Sowb. (cix, 5, 6), is the only species. Harvella has been considered a genus, with the two preceding groups as subgenera of it, but they are all essentially Mactras.

MACTRODESMA, Conrad, 1868. Shell subtriangular; cartilage-pit very large, ovate and projecting much beyond the lower margin of the hinge-plate; anterior hinge-margin in the right valve thick and continued much beyond the beak; hinge of left valve with a profoundly elevated Δ -shaped cardinal tooth, connected with the hinge-line above it only at the base of the tooth; lateral teeth short, thick, subequal; pallial sinus narrower and deeper than in Mactra, ending in a line opposite to the middle of the cartilage-pit; muscular scars very large. *M. ponderosa*, Conr. Miocene; Maryland.

PSEUDOCARDIUM, Gabb, 1866.

Etyim.—*Pseudo*, false, and *cardium*, a generic name.

Distr.—*Cardium Gabbi*, Remond. Miocene and Pliocene; California.

Shell thick, heavy, resembling *Lævicardium* externally; ligament internal; lunule cordate; left valve with a large cartilage-pit and a Δ -shaped tooth, which articulates in a corresponding depression in the right valve; two lateral teeth in each valve, very strong and prominent.

RANGIA, Desmoulins, 1832.

Syn.—Gnathodon, Rang, 1834. Clathrodon, Conr., 1837.

Distr.—1 sp. New Orleans. (3 other sp.? Mazatlan, California, Moreton B., Australia. Petit.) Fossil, 3 sp. Cret.—; Petersburg, Virginia.

Shell oval, ventricose; valves thick, smooth, eroded; epidermis olive; cartilage-pit central; hinge-teeth $\frac{2}{1}$; laterals doubled in the right valve, elongated, striated transversely; pallial sinus moderate.

Animal with the mantle freely open in front; margins plain; siphons short, partly united; foot very thick, tongue-shaped, pointed; gills unequal, the outer short and narrow; palpi large, triangular, pointed.

R. cyrenoides, Desm. (cix, 7), was formerly eaten by the Indians. At Mobile, on the Gulf of Mexico, it is found in colonies along with *Cyrena Carolinensis*, burrowing two inches deep in banks of mud; the water is only brackish, though there is a tide of three feet. Banks of dead shells, three or four feet thick, are found twenty miles inland. Mobile is built on one of these

ll-banks. The road from New Orleans to Lake Ponchartrain

(six miles), is made of Gnathodon shells procured from the east end of the lake, where there is a mound of them a mile long, fifteen feet high, and twenty to sixty yards wide; in some places it is twenty feet above the level of the lake.—LYELL.

RANGIANELLA, Conr., 1867. Lateral teeth straight, subequal, not elongated, entire. The only sp. is *R. trigona*, Petit.

PERISSODON, Conrad. *P. clathrodonta*, Conr. Miocene.

SUBFAMILY LUTRARIINÆ.

Shell usually oblong or elongated, sometimes oval, gaping behind; lateral teeth very small, rudimentary, sometimes obsolete, and especially in adult or old shells.

LUTRARIA, Lamarek, 1799.

Otter's-shell.

Syn.—Mactra (partim), Linn. Lutricola (partim), Blainv. Psammophila, Leach, 1827.

Distr.—33 sp. United States, Brazil, Britain, Mediterranean, Senegal, Cape, India, New Zealand, Sitka. Fossil. Tertiary—; United States, Europe. *L. oblonga*, Gmel. (cix, 8).

Shell oblong, gaping at both ends; cartilage-plate prominent, with 1 or 2 small teeth in front of it, in each valve; pallial sinus deep, horizontal.

Animal with closed mantle-lobes; pedal opening moderate; foot rather large, compressed; siphons united, elongated, invested with epidermis; palpi rather narrow, their margins plain; gills tapering to the mouth.

Resembles Mya; burying vertically in sand or mud, especially of estuaries; low-water to 12 fathoms. *L. rugosa*, found living on the coasts of Portugal and Mogador, is fossil on the coast of Sussex, England.

DARINA, Gray, 1849. Shell oblong, compressed, rounded and a little gaping at each extremity; beaks subposterior; hinge with a large, spoon-shaped pit; lateral teeth very small, confounded with the cardinal tooth. Ligament separated from the pit by a lamella. *L. Solenoides*, King (cix, 9). 53/

ZENATIA, Gray, 1849. (Metabola, Mayer.) Shell oblong, elongated, compressed; beaks not prominent, anterior, close; cardinal teeth distinct; lateral teeth none; ligament subexternal, marginal, not separated from the cartilage. *L. acinacies*, Quoy (cx, 11). 53/

CÆCELLA, Gray, 1849. Shell oblong, subequilateral; cardinal tooth of the left valve large, triangular; lateral teeth very narrow, contiguous to the cardinal tooth; cartilage-pit projecting; ligament marginal. *L. turgida*, Desh. (cx, 12). 53/

VANGANELLA, Gray, 1849. (Resania, Gray, 1849. Laminaria, Mayer. Myomactra, Mayer.) Valves with two interior diver- 53/

ging ribs; cardinal teeth of the left valve close together, those of the right valve separated; lateral teeth small, thin, confounded with the cardinal pit; ligament subexternal, marginal, not separated by a lamella from the internal cartilage, which is lodged in a triangular, elongated, shallow pit. *L. lanceolata*, Gray (ex, 10).

ANATINELLA, G. Sowerby, 1829.

Distr.—3 sp. Ceylon, Philippines; sands at low-water. *A. candida*, Chemn. (ex, 13). *A. Sibbaldi*, Sowb. (ex, 14).

Shell ovate, rounded in front, attenuated and truncated behind; cartilage in a prominent spoon-shaped process, with 2 small teeth in front; muscular impressions irregular, the anterior elongated; pallial line slightly truncated behind.

CARDILIA, Deshayes, 1835.

Syn.—Hemicyclonosta, Deshayes.

Distr.—2 sp. Chinese Sea, Moluccas. Fossil, 2 sp. Eocene—; France, Piedmont. *C. Martinii*, Desh. (ex, 15). *C. semisulcata*, Lam. (ex, 16). *C. inermis*, Desh. (ex, 17).

Shell oblong, ventricose, cordate; beaks prominent, subspiral; hinge with a small tooth and dental pit in each valve; ligament partly internal, contained in a spoon-shaped inflection; anterior muscular scar long, with a pedal scar above; posterior adductor impression on a prominent subspiral plate; pallial line simple.

STROTHODON, Giebel. Right valve tumid, high like Cardilia, beaks incurved, with a groove running from the beaks to the posterior margin, hinge with a flat cardinal tooth and with a second tooth projecting from its base below and anteriorly. Only one valve known, from the Triassic beds of Liskau (Germany), *St. Liscaviensis*. It has the general appearance of a Cardilia, but the hinge differs, and as the teeth are flat, the upper one appears to indicate, by its form, that it had supported a cartilage. Giebel says that an external ligament is also present, but it must have been rather thin, for the fulera are not perceptibly thickened.

HETEROCARDIA, Deshayes, 1854.

Distr.—3 sp. Philippines. *H. gibbosula*, Desh. (ex, 18).

Shell oval, subtrigonal, concentrically striate, gaping posteriorly; beaks small; hinge narrow; cardinal lamella narrow, canaliculated; pallial impression with a very deep 'sinus, extending as far as the anterior muscular impression.

PTEROPSIS, Conrad, 1860.

Distr.—*P. papyria*, Conr. (ex, 19). Eocene; Ala., So. Carolina.

Shell thin, ovate, equivalve; hinge-plate very broad, with an ovate cartilage-pit; anterior cardinal tooth very large and

elevated, A-shaped, anterior to the pit, bifid and extending to the inner margin of the cardinal plate; posterior tooth long, elevated, compressed, oblique; posterior cardinal plate widely and profoundly channelled. The left valve only is known.

TRESUS, Gray, 1849. 53/

Distr.—*T. maximus*, Midd. (cx, 20.) California.

Shell oval, oblong, ventricose, gaping posteriorly; cardinal tooth small, lateral teeth very small, connected with the cardinal; external marginal ligament separated from the cardinal pit by a lamina. 3/

SCHIZOTHÆRUS, Conrad, 1852. Very closely allied to Tresus, with a deep channel on either side of the cardinal teeth. The terminations of the siphons are protected by two solid valves. *T. Nuttalli*, Conrad (cx, 21).

EASTONIA, Gray.

Distr.—*S. rugosa*, Gmel.

Shell thick, oval, radiately ribbed; cardinal tooth of the left valve compressed; anterior lateral tooth nearly perpendicular.

MEROPE, H. and A. Ad., 1852. Shell thinner, radiately striated or ribbed. *E. Ægyptica*, Chemn. (cx, 23). 4/

LABIOSA, Schmidt, 1832.

Syn.—Cypricia, Gray. Leucoparia, Mayer.

Distr.—*L. lineata*, Say (cx, 24).

Shell oblong, widely gaping and reflected posteriorly; posterior slope narrow, defined by a carina; lateral teeth distinct, the anterior one oblique, near the cartilage-pit; ligament subexternal, marginal, not separated from the cartilage.

RÆTA, Gray, 1849. (*Lovellia*, Ch. Mayer.) Subcordate, ventricose, thin, concentrically plicate, subangulate and gaping behind; cardinal tooth strong; posterior lateral tooth small. *L. canaliculata*, Say (cx, 25). 53

FAMILY PAPHIIDÆ.

Shell subtrigonal, equivalve, close; ligament lodged in an internal cardinal pit; cardinal teeth simple, compressed; lateral teeth rudimentary; siphons separate, divergent.

PAPHIA, Lamarek, 1799.

Syn.—Eryx, Sw. (not Daud.).

Distr.—31 sp. West Indies, Mediterranean, Crimea, India, New Zealand, Chili; sands at low-water. Fossil; Miocene—. *P. trigona*, Desh. (cx, 26).

Shell trigonal, thick, compressed, closed; ligament internal, in a deep central pit; a minute anterior hinge-tooth, and 1—1

lateral teeth in each valve; muscular scars deep; pallial sinus small.

Animal with mantle-margins plain; siphons short, thick and separate, orifices cirrated, branchial cirri dendritic; foot compressed, broadly lanceolate; gills large, unequal; palpi small.

MESODESMA, Desh., 1830. Shell oval, subequilateral; lateral teeth short, smooth, subequal; siphonal inflection distinct. *P. erycinæ*, Lam. (ex, 27).

TARIA, Gray. Shell oblong, subequilateral, attenuated posteriorly; posterior margin carinated; lateral teeth very narrow. *P. lata*, Desh. (ex, 28).

CERONIA, Gray, 1849. Shell oval, cuneiform; truncated behind; lateral teeth subequal, compressed, coarsely obliquely striate; siphonal inflection distinct. *P. Jauresii*, Joannis (ex, 29).

DONACILLA, Lam., 1812. Shell elongate-cuneiform, slightly truncate posteriorly; anterior lateral teeth elongated, posterior short; siphonal sinus distinct. *P. donacilla*, Lam. (ex, 30).

ANAPA, Gray, 1849. Shell subtrigonal, ventricose, truncate posteriorly; lateral teeth subequal, compressed, smooth; siphonal inflection obsolete. *P. cuneata*, Lam. (ex, 31).

DAVILLA, Gray, 1849. Shell cuneiform-orbicular, somewhat truncated posteriorly; lateral teeth unequal, the anterior narrow, perpendicular. *P. crassula*, Desh. (ex, 32).

MACTROPSIS, Conrad, 1865. Resembles Anapa; it has in the left valve either one bifid or two diverging cardinal teeth, a distinct anterior, but less prominent posterior lateral tooth; possesses a small obtusely angular pallial sinus; in external appearance it looks very much like a Crassatella. Eocene; N. Am. *P. Grayi*, Lea.

ERVILIA, Turton.

Etym.—*Ervilia*, diminutive of *ervum*, the bitter-vetch. Lentil-shell.

Distr.—2 sp. West Indies, Britain, Canaries, Mediterranean, Red Sea, W. Coast America; 50 fathoms. *E. castanea*, Mont. (ex, 33).

Shell minute, oval, close; cartilage in a central pit; right valve with a single prominent tooth in front and an obscure tooth behind; left valve with two obscure teeth; no lateral teeth; pallial sinus deep.

FAMILY SEMELIDÆ.

Shell thin, subequivalve, gaping and usually flexuous posteriorly; external ligament short; cartilage internal, in a cardinal pit. Siphons elongated, separate and divergent.

SEMELE, Schumacher, 1817.

Etym.—*Semele*, in Greek myth, the mother of Bacchus.

Syn.—Amphidesma, Lamarck, 1818.

Distr.—60 sp. West Indies, Brazil, India, China, Australia, Peru. Fossil, 30 sp. Eocene—; United States, Europe *S. variegata*, Lam. (cx, 34). *S. reticulata*, Chemn. (cx, 35).

Shell rounded, subequilateral, beaks turned forwards; posterior side slightly folded; hinge-teeth 2·2, laterals elongated, distinct in the right valve; external ligament short, cartilage internal, long, oblique; pallial sinus deep, rounded.

SYNDOSMYA, Recluz, 1843.

Syn.—Abra, Leach, MSS.

Distr.—Norway, Britain, Mediterranean, Black Sea, India. Fossil, 6 sp. Eocene—; Britain, France. *S. alba*, Wood (cx, 36). *S. brevis*, Desh. (cx, 37).

Shell small, oval, white and shining; posterior side shortest; umbones directed backwards; cartilage-process oblique; hinge-teeth minute or obsolete, laterals distinct; pallial sinus wide and shallow.

Animal with the mantle open, fringed; siphons long, slender, diverging, anal shortest, orifices plain; foot large, tongue-shaped, pointed; palpi triangular, nearly as large as the gills; branchiæ unequal, triangular.

The species are few, and mostly boreal, ranging from the laminarian zone to 180 fathoms.—FORBES. They live buried in sand and mud, but when confined are able to creep up the sides of the vessel with their foot.

THEORA, H. and A. Adams, 1854.

Syn.—Endopleura, A. Ad.

Distr.—4 sp. Eastern seas. *T. lata*, Hinds (cx, 38).

Shell compressed, transversely oval, smooth, polished, gaping behind; ligament lodged in the cardinal pit; pallial sinus profound.

A. Adams considers the species of Theora to be without primary teeth, which certainly is not always the case. He consequently suggests for a peculiar Chinese form with a "primary tooth in front of the oblique cartilage-pit" and "with an internal rib extending from the beaks obliquely towards the anterior side," the name Endopleura as a subgenus. The internal rib may be characteristic, but this is not the case as regards the presence of cardinal teeth.

The Theoræ live in mud and sometimes brackish water. The animal has a strongly compressed, linguiform foot, and two perfectly separated long siphons.

LEPTOMYA, A. Adams, 1864.

Distr.—2 sp. *L. cochlearis*, Hinds.

Shell thin, ventricose, beaked posteriorly; surface of valves

lamellar; hinge with an oblique cartilage-pit in each valve; right valve with two anterior primary teeth, left valve with a single primary tooth; lateral teeth none; pallial sinus deep.

LEIOMYA, A. Adams, 1864. Shell hyaline, hinge with two prominent lateral teeth; in other respects identical with *Leptomya*. *Næra adunca*, Gould, is the type species.

SCROBICULARIA, Schumacher, 1817.

Syn.—Lavignon, Reaumur. Ligula, Mont. Listera, Turton. *Mactromya*, d'Orb.

Distr.—20 sp. Norway, Britain, Mediterranean, Senegal. Fossil, 4 sp. Tertiary; Europe. *S. piperata*, Gmel. (cx, 39; cxi, 41).

Shell oval, compressed, thin; subequilateral; ligament external, slight; cartilage-pit shallow, triangular; hinge-teeth small, one or two in each valve, laterals obsolete; pallial sinus wide and deep.

Animal with the mantle open, margins denticulated; siphons very long, slender, separate, orifices plain; foot large, tongue-shaped, compressed; palpi very large, triangular, gills minutely striated, the outer pair directed dorsally. Lives buried, vertically, in the mud of tidal estuaries, five or six inches deep.—MONTAGU. The siphons can be extended to five or six times the length of the shell.—DESHAYES. The animal has a peppery taste, but is sometimes eaten on the coasts of the Mediterranean.

LUTRICOLA (Blainv., 1824), Carpenter, 1865.

Syn.—*Capsa* (Bosc), H. and A. Adams.

Distr.—*L. Chemnitzii*, Desh. (cxi, 42).

Shell transversely elongately oval, cartilage-pit more vertical than oblique, cardinal tooth lamellar.

Lut. Chemnitzii, Desh., can be considered as the type. H. and A. Adams refer to their subgenus *Capsa* also a few species, like *Tell. lacunosa*, Chemn., *T. spectabilis*, Hanley, and some others; these latter must form a subgenus in the Tellinidæ; they have a subinternal ligament, but not a cartilage.

IACRA, H. and A. Adams, 1858. Shell subtrigonal, somewhat attenuated and produced posteriorly, subpellucid, surface of the valve divaricately sulcated, cartilage-pit oblique, narrow; one cardinal tooth in each valve in front of the cartilage-pit; lateral teeth close to the cartilage-process, more prominent in the right than in the left valve. 4 sp. Red Sea, Ceylon, Seychelles, Japan.

ŒDALINA, Carpenter, 1866.

Distr.—*Œ. subdiaphana*, Carp. California.

Shell inflated, thin, equivalve, equilateral, rounded; scarcely gaping, ligament external, cartilage subexternal; hinge with

three cardinal teeth in one and two in the other valve; all bifid; no lateral teeth, pallial sinus deep.

COOPERELLA, Carpenter. Cartilage subinternal, the ligament contiguous to it, the cardinal teeth lamellar, simple or one of them bifid. This subgenus is perhaps allied to *Metis*, H. and A. Adams.

CUMINGIA, Sowb., 1833.

Dedicated to Hugh Cuming, a very distinguished collector of shells; his cabinet now belongs to the British Museum.

Distr.—10 sp. In sponges, sand, and the fissures of rocks; 7 fathoms. W. Indies, India, Australia, West America. Fossil. Miocene—; Wilmington, North Carolina. *C. mutica*, Sowb. (ex, 40).

Shell transversely oval, equivalve, rounded in front, subrostrated and slightly gaping behind, small, thin, often irregular in form; hinge with a spoon-shaped cartilage-pit, and a small anterior cardinal tooth in each valve; two elongated lateral teeth in the right valve, less developed in the left; beaks small; surface concentrically ridged; pallial sinus very wide.

MONTROUZIERA, Souverb., 1863.

Dedicated to a French conchologist resident in New Caledonia, and who has greatly contributed towards a knowledge of its shell-fauna.

Distr.—2 sp. New Caledonia, Mauritius. *M. clathrata*, Souverb. (exi, 43–45).

Shell moderately elongated, hinge with the cartilage in a posteriorly directed groove, two cardinal teeth in front of it in the right valve, a single triangular, bifid one in the left; posterior, but quite close to the cartilage-pit, there is in each valve one short lateral tooth, looking, however, more like a posterior cardinal.

THYELLA, H. and A. Adams, 1865. Shell rather inflated, subtriangular, truncated posteriorly, surface decussated, striated; cartilage in an almost straight, projecting process; hinge in the right valve with two cardinal teeth, of which the anterior is bifid; in the left valve a single one bifid; no lateral teeth. *Th. pulchra*, from Singapore, is the only species as yet known.

FAMILY TELLINIDÆ.

Shell free, compressed, usually closed and equivalve; cardinal teeth 2 at most, laterals 1—1, sometimes obsolete; muscular impressions rounded, polished; pallial sinus very large; ligament on shortest side of the shell, external. Structure obscurely prismatic-cellular; prisms fusiform, nearly parallel with surface, radiating from the hinge in the outer layer, transverse in the inner.

Animal with the mantle widely open in front, its margins fringed; foot tongue-shaped, compressed; siphons separate, usually very long and slender; palpi large, triangular; gills united posteriorly, unequal, the outer pair sometimes directed dorsally.

The Tellens are found in all seas, chiefly in the littoral and laminarian zones; they frequent sandy bottoms, or sandy mud, burying beneath the surface; a few species inhabit estuaries and rivers. Their valves are often richly colored and ornamented with finely sculptured lines.

SUBFAMILY *TELLININÆ*.

Shell oval or wide, sometimes slightly gaping posteriorly; ligament external, prominent. Siphons elongated.

ASAPHIS, Modeer, 1793.

Syn.—Capsula, Schum., 1817. Capsa (part), Brug., 1791. Sanguinolaria, Lam., 1818, not 1801. Pliorhytis, Conrad.

Distr.—5 sp. West Indies, Red Sea, India, China, Australia. Fossil. Eocene—; United States, Europe. *A. deflorata*, Linn. (exi, 55).

Shell oblong, ventricose, slightly gaping at each end; radiately striated; cardinal teeth 2 in each valve, one of them bifid; ligament external, large, prominent; siphonal inflection short.

Animal like Psammobia; foot moderate; gills deeply plaited, attenuated in front, outer small, dorsal border wide, fixed; siphons moderate.

GARI, Schumacher, 1817.

Syn.—Psammobia, Lam., 1818. Sanguinolaria, Roissy, 1805. Lutricola (partim), Blainv., 1824. Psammosolen, Bronn, 1831.

Distr.—80 sp. Norway, Britain, India, New Zealand, Pacific; littoral—coralline zone, 100 fathoms. *G. gari* is eaten in India. Fossil, 55 sp. Cretaceous—; United States, Europe. *G. insignis*, Desh. (exi, 46). *G. vespertina*, Chemn. (exi, 68).

Shell transverse, oval-oblong, flat, equivalve, subequilateral, concentrically plicate, a little gaping on each side and covered by a thin epidermis; hinge narrow, with two small cardinal teeth, sometimes bifid, in each valve; beaks small; ligament long and prominent; margins simple; muscular impressions rather large, equally distant from the hinge, the anterior oblong, the posterior rounded; pallial impression distant from the margin, with a narrow, profound sinus.

Animal: mantle open, fringed; siphons very long, slender, nearly equal, longitudinally ciliated, orifices with 6–8 cirri; foot large, tongue-shaped; palpi long, tapering; gills unequal, recumbent, few-plaited.

The genus commenced in the cretaceous period, augmented during the tertiary, and is at its greatest development now.

PSAMMOCOLA, Blainv., 1824. Shell oblong, subquadrangular; surface smooth. *G. maxima*, Desh. (cxi, 47).

AMPHICHÆNA, Philippi, 1847. (*Psammobella*, Gray, 1851.) Shell oblong, gaping at both extremities; posterior end rounded. *G. modesta*, Desh. (cxi, 48).

HETEROGLYPHA, Martens, 1880. Posterior portion of the shell differently sculptured. *G. squamosa*, Lam.

SANGUINOLARIA, Lamarck, 1799.

Etym.—From the type, *Solen sanguinolentus*, Chemn.

Syn.—*Lobaria*, Schum., 1817.

Distr.—5 sp. *S. rosea*, Lam. (cxi, 49). Fossil; ? Paleozoic—.

Shell transverse, subelliptical, flattened, equivalve, inequilateral, a little gaping at the ends, not angulate posteriorly, covered by a thin, fugacious epidermis; hinge having two small, unequal, divergent cardinal teeth in each valve, the anterior of the left valve and posterior of the right valve being the largest; beaks small; ligament long; margins plain; muscular impressions subdorsal, the anterior oval, posterior circular; pallial impression elongated, with a shallow, narrow sinus.

HIATULA, Modeer, 1793.

Syn.—*Soletellina*, Blainv., 1824.

Distr.—40 sp. W. Indies, Red Sea, India, Madagascar, Japan, Australia, Tasmania, Peru. Fossil, 30 sp. Eocene—; U. S., Europe. *H. diphos*, Linn. (cxi, 50).

Valves oval-oblong, compressed, ventral margin usually incurved posteriorly, where the valves are attenuated; broadly rounded anteriorly; beaks submedian, not prominent; violaceous, under an olive epidermis; ligament thick, swollen; one or two very small cardinal teeth in each valve; muscular impressions rounded, distant; pallial impression very sinuous.

PSAMMOTÆA, Lam., 1818. Posterior slope a little angulated, but not rostrated. *H. violacea*, Lam. (cxi, 51).

PSAMMOTELLA, Blainv., 1826. Shell thin, oval or oblong, posterior edge rounded. *H. elongata*, Lam. (cxi, 52).

ELIZIA, Gray, 1852.

Distr.—2 sp. East Indies. *E. orbiculata*, Wood (cxi, 53, 54).

Shell suborbicular, equivalve, thin, compressed, covered by a shining epidermis; beaks not prominent, subanterior; hinge with two oblique cardinal teeth in the right valve, one of which is elongated and bifid, and three teeth in the left valve, the central one bifid; pallial impression submarginal.

TELLINA, Linn., 1758.

Etym.—*Telline*, the Greek name for a kind of mussel.

Distr.—Above 300 sp. In all seas, especially the Indian Ocean; most abundant and highly colored in the tropics. Low-water—coral zone, fifty fathoms. Wellington Channel, Kara Sea, Behring's Straits, Baltic, Black Sea. Fossil, 170 sp. Oolitic—; United States, South America (Chiloe), Europe. *T. rastellum*, Hanley (cxi, 56).

Shell slightly inequivalve, compressed, rounded in front, angular and slightly folded posteriorly, umbones subcentral; teeth 2·2, laterals 1—1, most distinct in the right valve; pallial sinus very wide and deep; ligament external, prominent.

Animal with slender, diverging siphons, twice as long as the shell, their orifices plain; foot broad, pointed, compressed; palpi very large, triangular; gills small, soft and very minutely striated, the outer rudimental and directed dorsally.

TELLINELLA, Gray, 1852. Shell oblong, elongated, posteriorly rostrated or subrostrated; hinge with two lateral teeth in one valve. *T. virgata*, Linn.

PERONÆODERMA, Poli, 1795. Shell oval, compressed, posteriorly subangular; hinge with two lateral teeth in one valve. *T. punicea*, Born (cxi, 57). Not very distinct from Tellinella.

MÆRA, H. and A. Adams, 1852. (*Donacilla*, Gray, 1851.) Shell oblong, Donaciform; posteriorly short, cuneiform, truncate; two lateral teeth in one valve. *T. donacina*, Linn. (cxi, 58—60).

PALÆOMÆRA, Stolicz., 1870. Shell elongated, hinder part shorter, the upper declivity slightly convex, posterior end subtruncate, beaks directed forwards; ligament situated on thickened but not prominent fulcræ; hinge with one anterior, long, lamelliform tooth in each valve, bifid in the right, single in the left valve, posterior cardinal tooth not distinctly traceable in either valve; laterals less distinct in the left valve. This is based upon the cretaceous *Tellina strigata* of Goldfuss. In form it very much resembles Mæra, but the hinge presents some marked differences, as noted above.

LINEARIA, Conrad, 1860. (*Liothyris*, Conr.) Shell elongated, sometimes roundish, not peculiarly thick, rounded on both ends, surface partially or wholly radiately ribbed, posteriorly not, or very indistinctly flexuous; anterior cardinal teeth on both valves elongated, bifid, much smaller in the left valve; posterior cardinal small, but larger in the left than in the right; lateral teeth much thinner in the left than in the right valve, sometimes almost obsolete in the former. This ought to include a large number of fossil species which have been described as *Arcopagiæ*; the want of posterior flexure or plicature and the usual radiate ribbings near the terminations of the shell particularly characterize

those species. Among recent shells they are represented by *Tell. concentrica*, Gould (not *id.* Reuss or d'Orb.), and one or two others. For many years palæontologists have separated these shells from Tellina and applied to them the name of Arcopagia. *T. metastrata*, Conr. (cxi, 61).

ARCOPAGIA, Leach, 1827. Shell rounded-oval or orbicular; two lateral teeth in one valve. *T. fausta*, Donov. (cxi, 62).

PHYLLODA, Schum., 1817. Shell oblong, much compressed, posteriorly angular and carinated; cardinal teeth divergent, sublamellar. *T. foliacea*, Linn. (cxi, 63).

ANGULUS, Schum., 1817. (Tellinula, Chemn. *Fabulina*, Gray, 1851.) Shell oblong, subtriangular, compressed; anteriorly rounded, posteriorly more or less pointed or angulated; a single lateral tooth in one valve. *T. polita*, Say (cxi, 64, 65).

TELLINIMERA, Conrad, 1860. (Tellimera, Conr., 1870.) Shell thin, elongated, subtriangular; right valve with three cardinal teeth, the shortest extending to the apex; left valve with two cardinal teeth, the posterior one bifid; no lateral teeth. Closely related to Angulus in form. *T. eborea*, Conr. (cxii, 100). Cret.; U. S.

TELLINIDES, Lamarck, 1818. Shell oval, compressed, slightly flexuous posteriorly; hinge with a single lateral tooth, contiguous to the cardinals. *T. Timorensis*, Lam. (cxi, 66).

HOMALINA, Stoliczka, 1870. (Homala, H. and A. Adams, not Schum.) Shell oblong, compressed, inequivalve, inequilateral, anteriorly short, rounded; posteriorly flexuous, obsoletely carinate, somewhat produced, narrowed; one lateral tooth near the hinge. *T. triangularis*, Chemn. (cxii, 99).

PERONÆA, Poli, 1791. (Omala, Schum., 1817.) Shell oblong, oval; anteriorly short, rounded, posteriorly somewhat flexuous, subangulate; lateral teeth obsolete. *T. planata*, Linn. (cxi, 67).

METIS, H. and A. Adams. Shell suborbicular, compressed, valves sillonated, posterior flexuosity submedian; no lateral teeth. *T. Meyeri*, Phil. (cxii, 69).

ÆNONA, Conrad, 1870. Shell subtriangular, inequilateral, hinge-margins equally declined, beaks not prominent, lunule very narrow, lanceolate, marked by a deeply impressed line; two very small, widely diverging cardinal teeth in the right valve, one bifid and one rudimentary tooth in the left valve. *T. Eufalensis*, Conrad (cxii, 70). Cretaceous; U. S.

[MACTROMYA, Agassiz, 1842. This group, which I have placed in Anatinidæ (p. 149), Stoliczka classifies as a distinct genus of Tellinidæ. Zittel refers species of Mactromya to several groups in Tellinidæ and Paphiidæ.]

ARCOPAGELLA, Meek.

Distr.—2 sp. Cretaceous; U. S. *A. Mactroides*, Meek (cxii, 6).

Shell equivalve, more or less equilateral, longer than high, with margins closed all around and smooth within. Hinge with two cardinal and one anterior and one posterior lateral teeth in each valve. Left valve with anterior cardinal tooth larger than the posterior, and trigonal in form, but sometimes rather deeply emarginated below, placed directly under the beak; posterior cardinal tooth small, slender, and ranging obliquely backward and downward close to the larger one, so as to leave only a slender pit between, corresponding to another on the anterior side of the principal cardinal tooth, which two pits are for the reception of the cardinal teeth of the right valve; anterior and posterior lateral teeth both elongated parallel to the cardinal margin, the former approaching more nearly to the cardinal teeth. Right valve with, under the apex, two diverging, slender, cardinal teeth, like the posterior one of the other valve, with a triangular pit between them for the reception of the principal cardinal tooth of the left valve; anterior one more oblique than the other, and nearly or quite connecting with the lateral tooth on that side; lateral teeth like those of the left valve; the anterior one apparently fitting under and the posterior above that of the other valve. Muscular impressions shallow; pallial impression with a moderate rounded sinus, directed obliquely forward and upward. Ligament unknown, but believed to be external. Surface without ornamentation.

STRIGILLA, Turton, 1822.

Distr.—17 sp. W. Ind., Panama, Polynesia, etc. Fossil; Tertiary. *S. carnaria*, Linn. (cxii, 71-73).

Shell orbicular, somewhat convex; surface with diverging striæ; no posterior flexure or carina; right valve with a large bifid cardinal tooth, left valve with a smaller, simple tooth; two lateral teeth in each valve; pallial sinus angular, profound.

MACOMA, Leach, 1819.

Syn.—Rexithærus, Conr.

Distr.—85 sp. World-wide. Fossil; Tertiary. *M. umbonella*, Lam. (cxii, 74).

Shell oval or subrotund, convex; cardinal teeth narrow; no lateral teeth; pallial impression with a profound sinus.

Animal with a single branchial lamella on each side. "The branchial apparatus," says Clark, "is curious, and a departure from the Tellina type; it consists of a single, rather elongated branchial plate on each side, situated towards the posterior half of the animal; it is fixed to the dorsal range by its base running obliquely, indeed almost vertically, from the dorsal to the ventral range, becoming joined to its fellow under the posterior and smaller part of the body by a permanent membrane." The palpi are very large and triangular.

TELLIDORA, Mörch, 1851.

Distr.—2 sp. W. Coast of Central America. Fossil, 1 sp. Pleistocene; So. Carolina. *T. Burnettii*, Brod. (exii, 75).

Shell subtriangular, rounded below, very inequivalve, right valve concave, left valve slightly convex; concentrically plicate, the plicæ forming teeth on the lateral margins; beaks angular, inclined anteriorly; two cardinal teeth in one valve, one in the other; two lateral teeth in each valve.

GASTRANA, Schumacher, 1817.

Syn.—Fragilia, Desh., 1848. Diodonta, Desh.

Distr.—5 sp. Norway, Britain, Mediterranean, Black Sea, Senegal, Cape. *G. fragilis*, Linn. (exii, 76, 77). Fossil. Miocene—; Britain, France, Belgium.

Shell equivalve, convex, with squamose lines of growth; cardinal teeth two in right valve, one bifid tooth in left; pallial sinus deep and rounded; umbonal area punctate; ligament external.

Animal with the mantle open in front, its margins fringed; siphons elongated, slender, separate, unequal, orifices with cirri; foot small, compressed, linguiform; palpi large, triangular; gills unequal, soft, finely striated.

Gastrana inhabits shallow water, boring in mud and clay, and not traveling about like the Tellens.

MACALIA, A. Adams, 1860. + *Tellinungula* Roem.

Distr.—*M. inquinata*, Desh. (exii, 78). Type *T. Bruguierei* Hanley.

Shell suborbicular, rather solid and inflated, posteriorly with a moderate ridge, nearly equivalve; the beaks are prominent, the ligament situated in a deep groove; the hinge with two very strong cardinal teeth in each valve.

QUENSTEDTIA, Morris and Lycett, 1853.

Dedicated to Prof. Quenstedt, palæontologist, of Würtemberg.

Syn.—Arcomya and Mactromya (in part), Agassiz.

Distr.—3 sp. Oolitic; England, France, Germany. *Q. oblita*, Phil. (exii, 98).

Shell oblong, equivalve, moderately solid, umbones nearly contiguous, hinge with a transverse cardinal tooth in the left, and a corresponding pit in the right valve; ligament external, placed in a long, narrow groove, pallial sinus small.

Only a few Jurassic species have as yet been referred to this genus; its systemic position is doubtful.

LUCINOPSIS, Forbes and Hanley, 1848.

Syn.—Lajonkairia, Desh. Mysia, Gray.

Distr.—6 sp. Europe, W. Indies, W. Coast of South America. *L. undata*, Pennant (exii, 79).

x This is a macoma!

Shell compressed, thin, suborbicular, two divergent, lamellar teeth in the right valve, three in the left valve, the middle one bifid; muscular impressions oval, polished; pallial line with a profound, ascending sinus.

Mantle-margins plain, pedal opening contracted; foot basal, pointed.

SUBFAMILY DONACINÆ.

Shell close, triangular, wedge-shaped, usually thick; ligament short.

Siphons short, separate, divergent.

DONAX, Linn., 1758.

Etym.—*Donax*, a sea-fish. (Pliny.) Wedge-shell.

Syn.—Chione, Scop. Cuneus, Da Costa, 1778. Capisterium, Meuschen.

Distr.—100 sp. United States, Norway, Baltic, Black Sea, all tropical seas. In sands near low-water mark (—8 fathoms), buried an inch or two beneath the surface. Fossil, 45 sp. Cret.—; United States, Europe. *D. denticulatus*, Linn. (cxii, 80, 81).

Shell trigonal, wedge-like, closed; front produced, rounded; posterior side short, straight; margins usually crenulated; hinge-teeth 2·2; laterals 1—1 in each valve; ligament external, prominent; pallial sinus deep, horizontal.

Animal with the mantle fringed; siphons short and thick, diverging, anal orifice denticulated, branchial with pinnate cirri; foot very large, pointed, sharp-edged, projected quite in front; gills ample, recumbent, outer shortest; palpi small, pointed.

LATONA, Schum., 1817. Shell oval, cuneiform, compressed behind, truncated in front; margin simple within. *D. cuneatus*, Linn. (cxii, 82).

HECUBA, Schum., 1817. Shell triangular, subcordiform; anterior side sharply angulated, flattened, produced; two lateral teeth in each valve. *D. scortum*, Linn. (cxii, 83, 85).

SERRULA, Chemn. Shell oval-triangular, cuneiform, gibbous in front; margins denticulated within; hinge with oblong cartilage-fissure. *D. trunculus*, Linn. (cxii, 86).

CAPSELLA, Gray. Shell oval-oblong, transversely elongated, subrounded at the extremities; covered with a greenish epidermis; margins of valves smooth within. *D. acutangulus*, Desh.

HETERODONAX, Mörch. Shell rounded-triangular, smooth, rather solid; two lateral teeth in each valve. *D. ovalinus*, Desh. (cxii, 87).

EGERELLA, Stoliczka, 1870. (*Egeria*, Lea, 1833, not Roissy or Leach.) Shell elongated, subtrigonal, anterior side much shorter than posterior; hinge with two cardinal teeth in each valve, one of which is bifid, lateral teeth none, sometimes they are indicated

by a thickening of the margins; ligament external, apparently on the shorter side, inner edge of shell occasionally crenated. Lea described several somewhat different species under this genus. Conrad referred the orbicular forms to *Mysia* and *Sphærella*, and *they* certainly belong to the Lucinidæ, reserving the name *Egeria* for such forms as *Eg. subtrigona* (cxii, 90) and *ovalis* of Lea. These shells externally very much resemble the subgenus *Mœra* of *Tellina*, but as the latter never have the inner margin crenated, it is probable that the present classification of the group is the more correct one. Conrad, in his Check List of Eocene North American Fossils (1866), refers seven species to the group. Deshayes and others describe similar tertiary forms.

ONCOPHORA, Rzehak, 1882. Founded upon *O. socialis*, Rzeh., a tertiary fossil, supposed to have inhabited brackish water. (Verh. K. K. Geol. Reichs., No. 3, 41, 1882.)

IPHIGENIA, Schumacher, 1817.

Syn.—*Capsa*, Lam., 1818. *Donacina*, Fer.

Distr.—5 sp. West Indies, Brazil, West Africa, Pacific, Cen. America. *I. Brasiliensis*, Lam. (cxii, 88). Inhabits estuaries. *I. ventricosa*, Desh., has eroded beaks.

Shell transverse, subequilateral, gibbous, covered with a thin olivaceous epidermis; hinge-teeth 2·2, one bifid, the other minute; laterals remote, obsolete in the left valve; margins smooth.

FISCHERIA, Bernardi, 1859.

Etym.—Dedicated to Dr. Paul Fischer, one of the able editors of the *Journal de Conchyliologie*.

Distr.—2 sp. *F. Delesserti*, Bern. (cxii, 89). Africa.

Shell transverse, equivalve, subequilateral, close, rather thick, with epidermis; right valve with a median, longitudinally channeled cardinal tooth, with additional rudimentary cardinals; left valve with a median pit (to receive the cardinal of the other valve), and two slightly oblique, lateral cardinals; right valve with extremely thin, compressed lateral teeth, none in the left valve; muscular impressions distinct, pallial sinus large and deep; ligament short, rather elevated.

GALATEA, Bruguiere, 1792.

Syn.—*Egeria*, Roissy, 1805. *Potamophila*, Sowerby, 1822. *Megadesma*, Bowdich, 1823. *Galateola*, Fleming, 1828.

Distr.—16 sp. Nile, and rivers of West Africa. *G. radiata*, Lam. (cxii, 91). *G. reclusa*, Born (cxii, 92).

Shell very thick, trigonal, wedge-shaped; epidermis smooth, olive; umbones eroded; hinge thick, teeth 1·2, laterals indistinct; ligament external, prominent; pallial sinus distinct.

Animal with the mantle open in front; siphons moderate, with 6–8 lines of cilia, orifices fringed; foot large, compressed; palpi

long, triangular; gills unequal, united to the base of the siphons, the external pair divided into two nearly equal areas by a longitudinal furrow, indicating their line of attachment.

SOWERBYA, d'Orbigny, 1850.

Etym.—Dedicated to Sowerby, author of "British Mineral Conchology," etc. *Syn.*—Isodonta, Buvignier, 1851.

Distr.—Fossil, 8 sp. Lower Lias—Portlandian; England, France, Germany. *S. Deshayesi*, Buv. (cxii, 93).

Shell equivalve, subequilateral; right valve with two oblique, diverging, cardinal teeth separated by a mesial trigonal socket, and two lamellar lateral teeth, separated from the hinge-border by longitudinal grooves; left valve with a conical tooth between two oblique pits; laterals two, longitudinal lamellar and projecting, and united to the superior border; ligament external.

FAMILY PETRICOLIDÆ.

Shell gaping, free, but frequently perforating clay or soft rocks, and therefore often irregular in form; white under a very thin epidermis; hinge narrow, bidentate in each valve; sinus of the pallial impression profound.

Animal with the mantle closed in front, much thickened and recurved over the edges of the shell; pedal opening small; foot small, pointed, lanceolate; siphons partially separate, orifices fringed, anal with a valve and simple cirri, branchial cirri pinnate; palpi small, triangular.

PETRICOLA, Lamarck, 1801.

Etym.—*Petra*, stone; *colo*, to inhabit.

Syn.—Choristodon, Jonas (in part).

Distr.—13 sp. United States, France, Red Sea, India, New Zealand, Pacific, West America (Sitka—Peru). Burrows in limestone and mud. Fossil, 20 sp. Cretaceous, Eocene—; United States, Europe.

Shell oval or elongated, thin, tumid, anterior side short; hinge with three teeth in each valve, the external often obsolete; pallial sinus deep.

PETRICOLARIA, Stoliczka, 1870. For the transversely elongated forms, of which *P. pholadiformis*, Lam. (cxii, 94), is the type. This species is very common, perforating clay or mud upon the sandy beaches of New Jersey.

RUPELLARIA, Fl. de Bellevue, 1802.

Syn.—Venerupis, Lam., 1818.

Distr.—30 sp. Europe, Pacific, etc. Fossil; Jurassic—. *R. foliacea*, Desh. (cvii, 96).

Shell elongated, moderately tumid, surface rugosely striated

and ribbed, distinctly gaping posteriorly; hinge in the right valve with two cardinal teeth, and a third very small, but usually obsolete, anterior; the middle one is prominent, curved as in *Petricola*; the posterior is longitudinally lamellar, low and bifurcate; in the left valve are three distant and very unequal cardinal teeth; the middle one is similarly projecting as the corresponding tooth in the other valve. *Rup. lamellifera*, Conrad, may be considered as a type of the group.

CHORISTODON (Jonas, 1844), H. and Adams, 1857.

Syn.—Naranio, Gray, 1853.

Distr.—3 sp. Polynesia, Mazatlan. *C. divaricatum*, Chemn. (cxii, 94).

Shell oval-quadrangular, rugose or tuberculose, swollen, beaks anterior; two cardinal teeth in each valve, the superior one of the right valve compressed and elongated, that of the left valve oblique and bifid; no lateral teeth; ligament external, short, in a deep groove; anterior muscular impression oblong, posterior one large, rounded; pallial sinus rounded, deep.

SAXIDOMUS, Conrad, 1837.

Distr.—Californian Province. *S. Nuttallii*, Conrad (cxii, 97).

Shell transversely oval, inequilateral, solid, ventricose, without lunule, umbones tumid; teeth three or four, unequal, narrow, the central bifid; ligament very thick, elongated; muscular impressions oval or rounded, nearly equal; pallial sinus large, elongated, horizontal.

FAMILY VENERIDÆ.

Shell regular, closed, suborbicular, or oblong; ligament external; hinge with usually three diverging teeth in each valve; muscular impressions oval, polished; pallial line sinuated.

Animal free, locomotive, rarely byssiferous or burrowing; mantle with a rather large anterior opening; siphons unequal, united more or less; foot linguiform, compressed, sometimes grooved; palpi moderate, triangular, pointed; branchia large, subquadrate, united posteriorly.

The shells of this tribe are remarkable for the elegance of their forms and colors; they are frequently ornamented with chevron-shaped lines. Their texture is very hard, all traces of structure being usually obliterated. The Veneridæ appeared first in the Oolitic period, and have attained their greatest development at the present time; they are found in all seas, but most abundantly in the tropics.

SUBFAMILY VENERINÆ.

Shell oval or subtrigonal. Siphons free to their extremity; foot lanceolate, without byssiferous groove.

VENUS, Linn.

Syn.—Antigona, Schum., 1817.

Distr.—176 sp. World-wide. Low-water—140 fathoms. *V. astartoides*, Behring's Sea. *V. verrucosa*, Britain, Mediterranean, Senegal, Cape, Red Sea, Australia? Fossil, 200 sp. Oolite—; Patagonia, United States, Europe, India. *V. verrucosa*, Linn. (cxiii, 7, 8). *V. puerpera*, Linn. (cxiii, 9).

Shell thick, ovate, smooth, sulcated, or cancellated; margins minutely crenulated; cardinal teeth 3—3; pallial sinus small, angular; ligament prominent; lunule distinct.

Animal with mantle-margins fringed; siphons unequal, more or less separate; branchial orifice sometimes doubly fringed, the outer pinnate; anal orifice with a simple fringe and tubular valve; foot tongue-shaped; palpi small, lanceolate.

MERCENARIA, Schum., 1817. (Crassivenus, Perkins, 1869.) Shell thick, ventricose, cordiform; margins crenulated within; three compressed, diverging teeth in each valve, the posterior of the right valve and anterior of the left valve strong and slightly bifid, the others lamellar; pallial sinus subtriangular. An American group, containing some of the largest and heaviest species of the genus. *V. tridacnoides*, a fossil of the United States, has massive valves, ribbed like the clam-shell. The North American Indians used to make coinage (wampum) of fragments of *Venus mercenaria* (cxiii, 10–12) by perforating and stringing them on leather thongs; this is the edible hard-shell clam largely consumed on and near the coast of the United States.

CRYPTOGRAMMA, Mörch, 1853. (Anomalocardia, Schum., 1817. Triquetra, Blainv., 1818.) Shell ventricose, triangular, prolonged, flexuous and attenuated posteriorly; hinge with three cardinal teeth in each valve, the anterior one of the right valve small; margins crenulated. *V. macrodon*, Lam. (cxiii, 13). *V. squamosa*, Linn. (cxiv, 30).

CHIONE, Megerle, 1811. (Murcia, Römer, 1867. Omphaloclathrum, Klein.) Shell oval, triangular or subcordiform; margins finely crenulated; hinge narrow, solid, with three teeth in the right valve and two in the left, the anterior tooth longest; ligament narrow; pallial sinus shallow. Mantle-margins folded and dentate; siphons short, unequal, the branchial doubly cirrated, the anal ciliated. *V. gnidia*, Brod. (cxiii, 14).

CIRCUMPHALUS, Klein, 1753. Surface of the valves lamellar. *V. plicata*, Gmel. (cxiii, 15, 16).

TIMOCLEA, Leach, Brown, 1827. (Leucoma, Römer, 1867.) Surface decussately striate. *V. grata*, Say.

CHAMELÆA, Klein, 1753. Surface concentrically striate. *V. aphrodinoides*, Reeve (cxiii, 17).

VENTRICOLA, Römer, 1867. Surface concentrically lamellate. *V. rugosa*, Chemn.

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MARCIA, H. and A. Adams, 1854. Surface of the valves smooth. *V. undulosa*, Lam. (cxiii, 18). 7/

KATELYSIA, Römer, 1857. *V. scalarina*, Lam.

ANAITIS, Römer, 1857. (Clausina, Brown.) Includes the moderately tumid cordate forms with strong concentric lamellæ. *V. plicata*, Gmel.

GOMPHINA, Mörch, 1856. Shell ovate, cordate, moderately inflated, smooth; hinge-teeth the same as in typical Chione. Römer describes four species, and considers *V. undulosa*, Lam., as the type, while H. and A. Adams quote *V. donacina*, Chemn. (cxiii, 19), as the only species, and place it as a subgenus of Cytherea (= Meretrix). 3/

VOLUPIA, Defrance, 1829. Shell minute, Isocardia-shaped concentrically ribbed, with a large lunule. *V. rugosa*, DeFr. Eocene; Hauteville.

PSEPHIS, Carpenter, 1865.

Distr.—3 sp. California. *P. Lordi*, Carp.

Shell thin, rounded or quadrangular, somewhat inflated; pallial sinus small; three elongated thin cardinal teeth in each valve. Oviparous, like Sphærium.

CYTHEREA, Lam., 1805.

Etym.—*Cytherea*, from Cythera, an Ægean island.

Syn.—Meretrix, Lam., 1799. Callistoderma, Poli, 1791. Corbicula, Benson.

Distr.—Same as Venus. Recent 150 sp. Fossil, 80 sp. Cre-taceous—. *C. petechialis*, Lam. (cxiii, 20).

Shell like Venus, oval-triangular, smooth; margins simple; hinge with three cardinal teeth and an anterior tooth beneath the lunule; pallial sinus moderate, angular.

Animal with plain mantle-margins; siphons united half-way.

CALLISTA, Poli, 1791. Shell oval, transverse, inequilateral; pallial sinus suboval, profound. Mantle-margins folded and cirrous above the siphons; siphons united, cirrated at their extremities. *C. erycina*, Linn. (cxiii, 21).

TIVELA, Link, 1807. (Trigona, Muhlf., 1811.) Shell triangular, subequilateral, cuneiform; three to five cardinal teeth in one valve, four to six in the other; anterior lateral tooth narrow, elongated, compressed; pallial impression with a short oblique or sometimes horizontal sinus. 28 sp. W. Indies, Mediterranean, Senegal, Cape, India, West America. Fossil. Miocene; Bordeaux. *C. radiata*, Sowb. (cxiii, 22).

PACHYDESMIA, Conr. (Trigonella, Conr., 1837.) *C. crassatelloides*, Conr., attains a diameter of five inches, and is very ponderous.

APIRODINA, Conrad, 1868. Shell rounded or suboval, striated or sulcated; hinge in the left valve with three diverging cardinal

teeth, the anterior as thick as the middle one, or thicker, and a straight, compressed, transversely rugose lateral tooth parallel with the margin above it; pallial sinus deep, and similar to that in *Caryatis*, Römer. *C. Tippana*, Conr. Cretaceous; U. S. Too closely allied to the next group.

CARYATIS, Römer, 1862. (Olim *Pitar*, Röm., 1857.) Shell cordate or subtrigonally ovate, usually of moderate thickness and somewhat inflated, white or yellowish brown colored, concentrically finely striated, pallial sinus always distinct, triangular or obtuse. *Venus tumens*, Gmelin, is the type of this very well-marked form of *Cytherea*; its distinction from others is of great importance in fossil conchology, for to it mostly appear to belong the oldest representants of the genus; of recent species, Römer describes sixty, and adds two doubtful ones. *C. Alcyone*, Römer (cxiv, 36, 37).

DOSINIOPSIS, Conrad, 1864. Shell exteriorly like *Dosinia*. Cardinal teeth three in each valve; posterior tooth of right valve bifid; in the left valve, a thick rugose lateral tooth fitting into a cavity in the opposite valve; under the umbo is a pit; cartilage-plate granulated; pallial sinus deep and angular. 3 sp. Eocene; United States. *C. lenticularis*, Rogers (cxv, 38).

DIONE, Gray, 1847. Shell moderately compressed, always concentrically densely sulcated, and with a more or less distinct ridge running from the beaks in an easy curve to the infero-posterior margin; this ridge is sometimes provided with spines; pallial sinus moderate, always distinct, usually linguiform. The type is *Venus dione*, Linn. Römer notices 13 sp. *C. lupanaria*, Desh. (cxiii, 23).

AMANTIS, Carp., 1865. Type, *Cytherea callosa*, Con. This group certainly does not deserve to bear a special name. It only differs by having the fulera thicker than most other species, and rugose. The general form and dentition of the hinge are extremely like *Cyth.* (*Callista*) *erycina*, Linn.

MACROCALLISTA, Meek. Shell transversely elongate-oval, with surface smooth; pallial sinus and hinge nearly typical, excepting that the sublunular or anterior lateral tooth is generally more compressed, more oblique, and more remote from the cardinal, and the posterior lateral much more elongated, and nearly horizontal. *Venus gigantea*, Gmelin.

ARTENIA, Conrad, 1870. Shell triangular, thick; surface with acute, concentric, prominent ribs; hinge with three cardinal teeth in the right valve, two of them diverging, distant, the anterior one under the apex robust, direct, curved; left valve with three diverging distant teeth; lateral tooth very small, pyramidal; pallial sinus very small and angular. *Cytherea staminea*, Con. (cxiv, 31). Tert.; U. S. This appears to be very close to some species of *Dione*.

GOULDIA, C. B. Ad., 1847. (Lioconcha, Mörch, 1853. Thetis, Ads., 1845.) Shell subtrigonal, oval, smooth, shining, inflated. *C. cerina*, Ads. (cxxiii, 66).

CIRCE, Schum., 1817. Shell rounded or oval; beaks flattened; surface concentrically sculptured; inner margin simple, or sometimes crenulated; middle cardinal teeth much stronger than the others; pallial impression truncated, but not sinuated posteriorly. *C. divaricata*, Chemn. (cxiii, 25).

CRISTA, Römer, 1857. Cordate or transversely ovate, solid, tumid, with radiating ribs or divaricating striæ; pallial sinus very small; internal margin crenated; ligament in a groove, but distinctly visible outside. *C. pectinata*, Linn. (cxiii, 26, 27).

SUBFAMILY MEROËINÆ.

Shell ovately elongated, moderately compressed; hinge with three or four compressed cardinal teeth, and one long lunular in each valve; the posterior margin behind the beaks is peculiarly flexured and bent inside, forming a deep cavity, sometimes with corrugated sides and containing the ligament hidden or almost hidden; lunule linear; pallial sinus distinct.

MEROË, Schum., 1817.

Etym.—Meroë, an island of the Nile.

Syn.—Cuneus (part), Megerle (not Da Costa, 1811). Sunetta, Link, 1807.

Distr.—11 sp. Senegal, India, Japan, Australia. Fossil: there are a few cretaceous and tertiary species. *M. picta*, Schum. (cxiii, 28).

Shell oval, compressed; anterior side rather longest; hinge with three cardinal teeth, and a long, narrow anterior tooth; lunule lanceolate; ligament in a deep escutcheon.

GRATELOUPIA, Desmoulins, 1828.

Distr.—Fossil, 4 sp. Eocene—Miocene; United States, France. *G. donaciformis*, Desm. (cxv, 41).

Shell subequilateral, rounded in front, attenuated behind; hinge with one anterior tooth, three cardinal teeth, and several small posterior teeth; pallial sinus deep, oblique.

CYTHERIOPSIS, Conrad, 1865. "Triangular; hinge composed of two compressed or linear teeth under the apex and two oblique anterior to them; in the left valve are four diverging teeth, the posterior one linear, and a lateral pyramidal compressed tooth anteriorly; cartilage-area rugose; pallial line with a shallow rounded sinus." *G. Hydana*, Conr. = *G. Moulinsii*, Lea (cxv, 29). Eocene; Alabama.

SUBFAMILY DOSINIINÆ.

Shell orbicular, mostly flattened and concentrically striate; pallial sinus oblique, triangular. Siphons united; foot subquad-rangular, without byssiferous furrow.

DOSINIA, Scopoli, 1777.

Syn.—Artemis, Poli, 1791. Orbiculus, Muhlf., 1811. Exoleta, Brown. Asa, Leach.

Distr.—100 sp. Boreal—Tropical seas; low-water—80 fathoms. Fossil, 13 sp. Cret.—; United States, Europe, South India. *D. discus*, Reeve (cxiv, 32).

Shell orbicular, compressed, concentrically striated, pale, ligament sunk; lunule deep; hinge like Cytherea; margins even; pallial sinus deep, angular, ascending.

Animal with a large hatchet-shaped foot, projecting from the ventral margin of the shell; mantle-margins slightly plaited; siphons united to their ends; orifices simple, palpi narrow.

GEMMA, Deshayes.

Syn.—Tottenia, Perkins, 1869.

Distr.—U. S. *G. gemma*, Totten (cxiii, 29).

Shell rounded, subtriangular, subequilateral, smooth, margins crenulated within; hinge short and narrow; three teeth in the left valve, the middle one conical, arcuated; two divergent teeth and an intermediate pit in the right valve; pallial impression marginal, with a narrow deep sinus.

The species of this genus are very small, not exceeding 3·5 mill. in diameter.

CYPRIMERIA, Conrad, 1864.

Distr.—Cretaceous; North America, Europe. *C. discus*, Matheron (cxv, 39, 40, 42).

Shell lentiform; hinge of right valve broad, with a bifid oblique cardinal tooth and two oblique acute anterior teeth, with an intermediate pit for the reception of the tooth in the opposite valve.

CYCLINA, Deshayes.

Distr.—10 sp. Senegal, India, China, Japan, West America. Fossil, 1 sp. Miocene; Bordeaux. *C. Chinensis*, Chemn. (cxiv, 33).

Shell orbicular, somewhat convex, close; margins usually finely crenulated; beaks inclined anteriorly, no lunule; three small cardinal teeth, narrow, divergent and unequal; no lateral teeth; two large muscular impressions, anterior oval, posterior semilunar; pallial impression short, the sinus deep and angular; ligament long and narrow.

CLEMENTIA, Gray, 1840.

Distr.—6 sp. Australia, Philippines. *C. papyracea*, Gray (cxv, 43).

Thin, oval, white; ligament semi-internal; posterior teeth bifid, sinus deep and angular.

Animal with long, united siphons, and a large crescentic foot, similar to *Dosinia*.

THETIS, Sowerby, 1826.

Syn.—*Thetironia*, Stolicz., 1870.

Distr.—Cretaceous. *T. major*, Sowb. (cxv, 44). *T. hyalina*, Sowb. (cxiv, 34).

Shell thin, oval-subtrigonal, close, smooth, or concentrically striate; three unequal, parallel, narrow cardinal teeth in each valve, the posterior longest, lamelliform in the right, longer and thicker in the left valve; beaks rather large, inclined forwards; margins thin, simple; ligament narrow, inflated; muscular impressions submarginal; pallial impression slight, with a profound double sinuosity.

ÆORA, Conrad, 1870.

Distr.—*Æ. cretacea*, Conr. (cxxi, 4). Haddonfield, N. J.

Shell roundly ovate; right valve with three diverging cardinal teeth, posterior one bifid; cardinal-plate broad, deeply channeled anteriorly, with a compressed, lateral tooth in the middle of the channel; plate deeply channeled posteriorly. Left valve with three diverging cardinal teeth, the anterior one A-shaped, oblique; one distant anterior lateral tooth with a channel above, parallel with the cardinal margin; nymphæ crenulated on the upper margin, a distant narrow channel on the posterior hinge-plate; pallial sinus deep, reaching to a point in a line with the posterior extremity of the posterior cardinal tooth; rounded and somewhat ascending.

Conrad says that this genus is nearly related to *Isodoma*, but it appears to be very like *Cyclina* and *Thetis*. The type species in general external characters of the shell also closely resembles some *Cyprimeriæ*.

SCALDIA, Ryckholt, 1852.

Distr.—2 sp. Carboniferous; Belgium. *S. Lambotheana*, Ryck. (cxv, 45).

Shell equivalve, roundly ovate, moderately tumid, with concentric striæ of growth; muscular scars two, anterior larger than posterior; pallial line with an angular, somewhat ascending sinus, as in *Dosinia*; hinge-line of the left valve with a single, tubercular, cardinal tooth below the umbo.

SUBFAMILY TAPESINÆ.

Shell oblong, transverse; cardinal teeth compressed; laterals, when present, simple. Siphons separate; foot lanceolate, byssiferous.

TAPES, Mühlfeldt.

Etym.—*Tapes*, tapestry.

Syn.—*Omalia*, Ryck., 1856. *Parembola*, Römer.

Distr.—78 sp. Norway, Britain, Black Sea, Senegal, Brazil, India, China, New Zealand; low-water—100 fathoms.—BEECHY. Fossil, 6 sp. Cretaceous—; Britain, France, Belgium, Italy. *T. litterata*, Linn. (cxiv, 35). *T. geographica*, Chemn. (cxiv, 36).

Shell oblong, umbones anterior, margins smooth; teeth three in each valve, more or less bifid; pallial sinus deep, rounded.

Animal spinning a byssus; foot thick, lanceolate, grooved: mantle plain or finely fringed; freely open in front; siphons moderate, separate half-way or throughout, orifices fringed, and cirri simple, branchial ramose; palpi long, triangular.

The animal is eaten on the southern European coasts; it buries in the sand at low-water, or hides in the crevices of rocks, and roots of sea-weed.

AMYGDALA, Römer. (*Cuneus*, Dacosta.) Radiately striate or decussate. *T. decussata*, Linn.

MYRSUS, H. and A. Ad., 1858. (*Metis*, Ad., 1857.) Concentrically wrinkled. *T. corrugata*, Desh.

PARATAPES, Stolicz., 1870. (*Textrix*, Römer, not Blachwall or Sundewal, 1833, = *Arachnoidea*.) Shell much elongated, compressed, outer surface smooth. *T. textrix*, Chemn.

HEMITAPES, Römer. Shell inflated, solid, ventricose, especially at the umbones, which are incurved, more or less narrower posteriorly; outer surface smooth. *T. pinguis*, Chemn.

PULLASTRA, Sowb. 1827.

Distr.—Eastern seas. *P. Malabarica*, Chemn. (cxiv, 37).

Shell transverse, oblong, oval and sometimes subtrigonal; hinge composed of three contiguous cardinal teeth, more or less divergent, sometimes bifid or simply channeled at the summit; beaks directed forward; margins simple; anterior muscular impression oval, posterior larger and rounded; pallial impression rather distant from the margin, with an oval, shallow sinus.

Animal with membranous, transparent mantle, the margins plain; siphons partly separate, unequal, the extremities with small tentacles, branchial siphon largest and longest; foot elongated, compressed, triangular, sometimes byssiferous; branchiae unequal, united behind the foot and around the anal siphon; mouth oval, small.

LIOCYMA, Dall, 1870.

Distr.—2 sp. *L. fluctuosa*, Gould (cxxiii, 87).

Shell small, ovate, concentrically striated, compressed, nearly equivalve and rather thin; there are in each valve three cardinal teeth, the middle one cleft; pallial sinus small.

BARODA, Stoliczka, 1870.

Distr.—*B. fragilis*, d'Orb. (cxxi, 1-3). Cretaceous.

Shell very much elongated, very inequilateral, with subparallel upper and lower margins laterally compressed, pallial sinus moderate, horizontal or nearly so, obtuse at the end; hinge with three cardinal teeth in each valve, the posterior of which is very much elongated and sometimes longitudinally furrowed; the two other teeth sometimes appear as one widely bifid tooth; surface of valve smooth, only with concentric striæ of growth.

ICANOTIA, Stoliczka, 1869. Form similar to the last, inner edge of the shell anteriorly somewhat thickened, surface covered with radiating striæ and ribs, strongest on the posterior upper slope. *Psammobia impar*, Zittel.

FAMILY GLAUCOMYIDÆ.

Shell transverse, with a greenish epidermis. Siphons very long, compressed, united nearly to the extremity, which is fringed; foot large, linguiform, compressed, subcarinated.

GLAUCOMYA (Bronn), Gray.

Etym.—*Glaucos*, sea-green; *mya*, mussel.

Syn.—*Glaucanome*, Gray, 1829 (not Goldfuss, 1826).

Distr.—16 sp. Embouchures of rivers; China, Philippines, Borneo, India. Fossil, 2 sp. Tertiary; Europe. *G. rugosa*, Reeve (cxii, 3-5).

Shell oblong, thin; epidermis dark, greenish; ligament external; hinge with three teeth in each valve, one of them bifid; pallial sinus very deep and angular.

Animal with a rather small, linguiform foot; pedal opening moderate; siphons very long, united, projecting far into the branchial cavity when retracted, their ends separate and diverging; palpi large, sickle-shaped; gills long, rounded in front, the outer shortest.

TANYSIPHON, Benson, 1855. Siphons united to the end; hinge with three teeth in the right and two in the left valve; pallial sinus very deep. Calcutta, buried in mud at extreme low-water. *G. rivalis*, Benson (cxii, 1, 2).

SUBORDER INTEGRIPALLIATA.

Siphons short, not retractile; the pallial impressions simple, usually without siphonal sinus.

(Cyrenacea.)

FAMILY CYRENIDÆ.

Shell suborbicular, closed, ligament external; epidermis thick, horny; umbones of aged shells eroded: hinge with two or three cardinals and lateral teeth; pallial line with a small inflection.

Animal with mantle open in front, margins plain; siphons (1 or 2) more or less united, orifices usually plain; gills two on each side, large, unequal, united posteriorly; palpi lanceolate; foot large, tongue-shaped.

Mr. Temple Prime, who has made a special study of this family, asserts that Oriental species of *Cyrena* and *Corbicula* differ from the American in not having a pallial sinus, but Dr. Stoliczka has observed it in Asiatic species, although not so well-developed as in those inhabiting America; it is present, but shallow, in fossil species of the Paris Basin.

CYRENA, Lam., 1806.

Ety.—*Cyrene*, a nymph.

Syn.—*Pseudocyrena*, Bourg., 1856. *Cyanocyclas*, Fer., 1818. *Cyrenocyclas*, Agass., 1847. *Polymesoda*, Raf., 1820. *Leptosiphon* and *Cyrenocapsa*, Fischer. *Miodon*, *Ditypodon*, *Loxoptychodon* and *Donacopsis*, Sandberger.

Distr.—100 sp. South America, Southern United States, East Indies, Polynesia. Fossil. Cretaceous—; North America, Europe. *C. Cyprinoides*, Quoy (cxiv, 38).

Shell rather thick, inflated or a little compressed, rounded or subtrigonal, subinequilateral, close, covered with a thick, greenish epidermis; three subequal, divergent, cardinal teeth in each valve; lateral teeth two, smooth or striated, the anterior rather thick, short, close, the posterior sublamellar, distant; beaks contiguous, eroded; ligament long and swollen; margins simple; muscular impressions small, oblong; pallial sinus inconspicuous.

Animal with the mantle open in front and below, margins plain; siphons short, orifices fringed; gills unequal, square in front, plaited, inner lamina free at base; palpi lanceolate; foot strong, tongue-shaped.

Cyrena inhabits the brackish waters of warm countries; they are usually found near the coast, often buried in the mud of mangrove-swamps. *C. Carolinensis*, Bosc, occurs plentifully in the rivers and swamps of So. Carolina, Georgia and Florida.

EGETA, H. and A. Adams, 1857. (*Anomala*, Desh.) Shell ventricose, thin, anteriorly short, posteriorly longer, subrostrated. *C. Floridana*, Conr. (cxv, 31).

DIOEUS, Gabb, 1868. (*Cyprinella*, Gabb, olim.) Shell equi-valve, subcordiform; hinge with three diverging (simple?) cardinal teeth, and one anterior and one posterior lateral smooth

tooth in each valve; pallial sinus shallow. Perhaps scarcely subgenerically distinct from *Cyrena*. For a doubtfully cretaceous species. *D. tenuis* (cxv, 32).

ISODOMA, Desh. Shell thin, fragile, resembling a *Clementia*, elongately ovate, moderately tumid; hinge of right valve with two bifid diverging cardinal teeth, and one distinct remote lateral tooth on either side; pallial sinus slight. Based on *I. cyrenoides*, Desh. (cxv, 33, 34); Paris Basin. It recalls *Clementia* in general character, but the dentition of the hinge is distinctly that of *Cyrenidæ*.

VELORITA, Gray, 1834.

Distr.—3 sp. Philippines, India, Japan. *V. Cyprinoides*, Gray (cxiv, 39, 40).

Shell with epidermis, cordiform, triangular, thick, solid; three cardinal teeth, the anterior one of the right valve and posterior of the left rather small; lateral teeth large, very finely striated, the anterior very large, triangular, the posterior compressed, elongated.

BATISSA, Gray, 1847. 53/

Distr.—30 sp. Polynesia, Australia, E. Indies. *B. violacea*, Lam. (cxiv, 41–43).

Shell subcordiform, solid, covered with a horny, greenish epidermis; three cardinal teeth in each valve, the right anterior and left posterior ones rather small; lateral teeth compressed, striated, the anterior very short, posterior elongated.

CORBICULA, Muhlf., 1811.

Distr.—120 sp. India, East Indies, Philippines, So. America. *C. cor*, Lam. (cxiv, 44–46). Fossil. Laramie; N. America.

Shell subcordiform, solid, close, concentrically striated or ridged, covered by a smooth, greenish epidermis; three cardinal teeth in each valve, the right anterior and left posterior rather small; lateral teeth elongated, compressed, striated; ligament prominent, thick; pallial impression with a slight or well-marked sinus.

VELORITINA, Meek. Shell thick, gibbous, obliquely cordate-trigonal; beaks elevated, obliquely incurved, and tumid; posterior umbonal slopes very prominently rounded; posterior dorsal margins strongly incurved; cardinal teeth typical, excepting in being more oblique; lateral teeth with striae very minute or obsolete, the posterior one of the left valve often appearing as if merely formed by the beveled edge of the incurved dorsal margin; ligament small and depressed far below the elevated umbonal slopes; surface concentrically striated. *Corbicula Durkeei*, Meek.

LEPTSTHES, Meek. Shell transversely elongate-subovate, compressed, typically extremely thin, very oblique; beaks depressed,

subanterior; hinge-plate rather wide; cardinal and lateral teeth typical, excepting that the cross-striæ are very obscure or obsolete and the posterior lateral rather short and very remote from the cardinal, with a wide, flattened space intervening; surface concentrically striated. *Corbicula fracta*, Meek.

SPHÆRIUM, Scopoli, 1777.

Syn.—Cyclas, Brug., 1792. Cornea, Muhlf., 1811. Corneocyclas, Fer., 1818.

Distr.—75 sp. Universal. Fossil. Laramie—; N. America. Eocene—; Europe. *S. corneum*, Linn. (cxiv, 47).

Shell thin, oval or suborbicular, inflated, covered by a greenish epidermis; cardinal teeth very small or rudimentary, one more or less bifurcated, one in the right and two oblique ones in the left valve; lateral teeth compressed, lamelliform, the anterior shortest; ligament short; margins plain, muscular impressions scarcely apparent, submarginal; pallial impression simple.

Animal oval, subglobular; mantle-margins plain; siphons unequal, not ciliated, short, only united at the base, the branchial one largest and longest; mouth small, oval, transverse; branchial large, unequal, united behind, the inner ones largest; foot tongue-shaped, triangular, flattened, very extensible.

The fry of Sphærium are hatched in the *internal* branchiæ, they are few in number and very unequal in size; a full-grown *C. cornea* has about six in each gill; the largest being one-sixth to one-fourth the length of the parent. The young Sphæria and Pisidia are very active, climbing about submerged plants and often suspending themselves by byssal threads; the striated gills and pulsating heart are easily seen through the shell.

CYRENASTRUM, SPHÆRIASTRUM, Bourg.; CORNEOLA, CALYCVLINA, Clessin, are names given to sections of the genus, possessing but slight differential characters.

PISIDIUM, Pfeiffer, 1821.

Syn.—Pera, Leach? Musculium, Link, 1807. Pisum, Muhlf., *Gray* 1811. 1853.

Distr.—60 sp. Universal. Fossil. Laramie; N. Am. Eocene—; Europe. *P. compressum*, Prime (cxiv, 48; cxv, 48).

Shell suboval, trigonal, inequilateral, covered by a greenish epidermis; cardinal teeth very small, elongated, one, sometimes bifurcated, in the right valve, two, diverging, in the left valve; lateral teeth longitudinal, compressed, lamelliform, double in the right valve.

Siphons short, simple, contractile, united to the end; foot linguiform, flattened, very extensible.

This is closely related to the preceding genus; but Pisidium has siphons united to the end, short; Sphærium, siphons elongated, separate. In Pisidium the cardinal teeth are elongated,

diverging; in *Sphærium*, tubercular or of columnar shape, placed obliquely toward each other.

EUPERA, Bourg., and *FLUMINEA*, *RIVULINA* and *FOSSARINA*, Clessin, are names of sections of the genus; they have but little distinctive value.

CYRENOIDES, Joannis, 1835.

Syn.—*Cyrenella*, Desh., 1833.

Distr.—4 sp. River Senegal. The marine species are *Diplo-*
dontæ. Fossil, 1 sp. Europe. *C. Dupontii*, Joannis (cxiv, 49).

Shell orbicular, ventricose, thin, eroded at the beaks; epidermis dark olive; ligament external, prominent, elongated; cardinal teeth 3·2, the central tooth of the right valve bifid; muscular impressions long, narrow; pallial line simple.

Animal with mantle open in front and below, margin simple, siphons short, united; palpi moderate, narrow; gills very unequal, narrow, united behind; foot cylindrical, elongated.

? *CYCLOCONCHA*, Miller, 1874.

Distr.—*C. mediocardinalis*, Miller. L. Silur.; U. S.

Shell nearly circular, equivalve, concentrically sculptured, with a hinge-tooth and posterior and anterior laterals.

Its pertinence to this family is doubtful.

(*Cardiacea*.)

FAMILY CYPRINIDÆ.

Shell regular, equivalve, oval or elongated; valves close, solid; epidermis thick and dark; ligament external, conspicuous; cardinal teeth three in each valve, and a posterior lateral tooth; pedal scars close to, or confluent with, the adductors; pallial line slightly sinuous; siphons very short, with ciliated orifices; foot thick, linguiform.

CYPRINA, Lamarck, 1812.

Etym.—*Kuprinos* (from *Kupris*), related to Venus.

Syn.—*Arctica*, Schum., 1817.

Distr.—*C. Islandica* (cxiv, 50–52) ranges from Greenland and the United States to the Icy Sea, Norway and England; in 5–80 fathoms water. It occurs fossil in Sicily and Piedmont, but not alive in the Mediterranean. Fossil, 90 sp. (D'Orbigny.) Muschelkalk—; Europe, U. S.

Shell oval, large and strong, with usually an oblique line or angle on the posterior side of each valve; epidermis thick and dark; ligament prominent, umbones oblique; no lunule; cardinal teeth 2·2, laterals 0—1, 1—0; muscular impressions oval, polished; pallial sinus obsolete.

Animal with the mantle open in front and below, margins

plain; siphonal orifices close together, fringed, slightly projecting; outer gills semilunar, inner truncated in front.

The principal hinge-tooth in the right valve of *Cyprina* represents the second and third in *Venus* and *Cytherea*; the second tooth of the left valve is consequently obsolete.

CICATREA, Stoliczka, 1870. Shell with a sharp, high ridge; beaks distant and strongly incurved, with a short deeply bifurcate groove running posteriorly from each, in which is lodged the ligament; posterior cardinal teeth rather narrow in both valves (while in *Cyprina* proper the one in the right valve is very thick and bifurcate); the two anterior cardinals in the left valve are very large, the same superimposed teeth in the right valve, however, very small; the anterior muscular impression is anteriorly margined by a sharp ridge. The form of the shell strongly recalls *Hemicardium*. *Cyv. cordialis*, Stol. Cretaceous; India.

CYPRINOPSIS, Conrad, 1869, is characterized as equivalve, two anterior cardinal teeth and one very oblique tooth in the right valve, pallial line entire. *Artemis elliptica*, Smith. Does not appear to differ much from a typical *Cyprina*.

VELEDA, Conrad, 1870. Ovately elongated, tumid, posteriorly ridged from the umbo, concentrically striated on the surface, equivalved; left valve with a Λ -shaped cardinal tooth under the apex and three compressed teeth, posterior one elongated and parallel with the dorsal margin, cardinal plate channeled, deeply so anteriorly. *V. linteæ*, Con. (cxv, 35). In this group also, the distinction from typical *Cyprina* appears to be unimportant.

GONIOSOMA, Conrad, 1869.

Distr.—*G. inflata*, Conr. Cret.; New Jersey.

Shell subquadrangular, moderately tumid, angular along the region from the beak to the infero-posterior end; muscular impressions marginal, pallial line—? hinge in the right valve with two prominent cardinal teeth and a long anterior lateral, parallel with the hinge-margin.

VENIELLA, Stoliczka, 1870.

Syn.—*Venilia*, Morton, 1834, not Duponchel, 1829, nor Alder and Hancock.

Distr.—Jurassic—Tertiary; U. S., Europe. *V. tumida*, Nyst. (cxv, 53).

Shell ventricose, inflated, umbonal slope posteriorly angulate, with the beaks outwardly incurved, more or less distant, a long narrow ligamental furrow running from them posteriorly, hinge with three cardinal and one posterior lateral tooth in each valve; right valve with the supra-posterior cardinal tooth, generally bifid anteriorly with a hook-like downward bent prolongation, infero-anterior cardinal smaller, lamelliform, or more or less tubercular, separated from the other tooth by a more or less

horizontally extending flexuous groove into which the infero-anterior cardinal tooth of the left valve fits, the supero-posterior cardinal of this valve is moderately prolonged, single or indistinctly bifid.

ANISOCARDIA, Munier-Chalmas, 1863. Surface radiately marked, umbonal ridge not angular. Cretaceous, Eocene. Type, *V. elegans*, Munier-Chalmas (cxv, 54-56), Kimmeridge clay, Havre.

VENILICARDIA, Stol., 1870. Shell, of large size, strong and thick, the supero-posterior cardinal teeth are usually more or less bifid, the one in the right valve with a very easy curve at the anterior end, the antero-inferior cardinal teeth of both valves are long, flexuous, and their posterior ends are in both cases strongly thickened and tubercular. Jurassic, Cretaceous, Tertiary. Type, *V. arcotica*, Stolicz. Cretaceous; India. *V. cordiformis*, d'Orb. (cxv, 57).

FAMILY ISOCARDIIDÆ.

Shell cordiform or transversely oblong, ventricose, sometimes carinated; beaks sometimes subspiral; two cardinal and two lateral teeth in each valve, the anterior lateral tooth occasionally obscure or rudimentary; muscular impressions narrow; pallial line simple.

ISOCARDIA, Lamarck, 1799.

Etym.—*Isos*, like, *cardia*, the heart. Heart-cockle.

Syn.—Glossus and Glossoderma, Poli, 1791. Bucardium, Muhlfeldt. Tychocardia, Römer.

Distr.—5 sp. Britain, Mediterranean, China, Japan. Fossil, 90 sp. Trias—; United States, Europe, South India. *I. cor*, Linn. (cxiv, 53-55).

Shell cordate, ventricose; umbones distant, subspiral; ligament external; hinge-teeth 2·2; laterals 1—1 in each valve, the anterior sometimes obsolete.

Animal with the mantle open in front; foot triangular, pointed, compressed; siphonal orifices close together, fringed; palpi long and narrow; gills very large, nearly equal.

The heart-cockle burrows in sand, by means of its foot, leaving only the siphonal openings exposed.—BULWER.

The Isocardia-shaped fossils of the old rocks belong to the genera *Cardiomorpha* and *Isoarca*; many of those in the Oolites to *Ceromya*. Casts of true *Isocardia* have only two transverse dental folds between the beaks, and no longitudinal furrows.

MIOCARDIA, H. and A. Adams, 1856. Shell without epidermis; beaks strongly curved, spiral; posterior umbonal slope carinated; surface concentrically ridged. *I. Moltkiana*, Chemn. (cxiv, 56).

CARDIODONTA, Stol., 1867. Shell cordiform, inflated, with prom-

inent incurved beaks, hinge with two cardinal and one thin or lamellar posterior lateral tooth in each valve; ligamental groove long, narrow, marginal; right valve with a strong, grooved posterior and one oblique simple anterior cardinal tooth, the latter running from the beak more or less parallel to the lunular margin; left valve with a single posterior and a thick anterior cardinal tooth strongly prominent above. *I. Balinensis*, Laube (cxv, 58-60).

CALLOCARDIA, A. Ad., 1864. Shell cordate and inflated like in Isocardia, posteriorly scarcely flexuous, thin and without epidermis; hinge of the left valve with two unequal cardinal teeth, the anterior angularly bent on itself in the middle with a triangular pit on either side and with four prominent cusps at the margin; the posterior oblique, curved, narrow, but elongated, and with two indistinct marginal cusps; no lateral teeth are present; pallial line simple and muscular impressions semilunar. There is as yet only one (left) valve of this remarkable species, *C. guttata*, known from the Chinese Seas. The absence of the posterior lateral tooth, as well as the peculiar cuspidation of the two hinge-teeth, distinguish it.

ISOCULIA, M'Coy, 1844. Under the name of *I. ventricosa*, M'Coy (cxv, 61) figures a very tumid, cordate shell with a few concentric distant constrictions, indicating stages of growth. The shell appears perfect and closed.

CYPRICARDIA, Lamarek, 1819.

Syn.—Trapezium, Muhlfeldt, 1811. Libitina, Schum., 1817.

Distr.—13 sp. Red Sea, India and Australia; in crevices of rock and coral. Fossil, 60 sp. Jurassic—; North America and Europe. *C. rostrata*, Lam. (cxvi, 68, 69).

Shell oblong, with an oblique posterior ridge; umbones anterior, depressed; ligament external, in deep and narrow grooves; cardinal teeth 2·2, laterals 1—1 in each valve, sometimes obscure; muscular impressions oval (of two elements); pallial line simple.

Animal (of *C. solenoides*) with mantle-lobes united, cirrated behind; pedal opening moderate; foot small, compressed, with a large byssal pore near the heel; siphons short, conical, unequal, cirrated externally; orifices fringed; palpi small; gills unequal, the outer narrower and shorter, deeply lamellated, united posteriorly, the inner prolonged between the palpi.

APRICARDIA, Gueranger, 1867. Shell elongated, inequilateral; hinge with one strong, recurved tooth in each valve, the tooth being in the left valve almost directly under the beak and in the right a little posterior to it; to each tooth corresponds an equally large cavity in the other valve. This peculiar form resembling

Cypricardia is distinguished by the simple form of its hinge; it is based upon a cretaceous species, *Cpr. carinata*.

GLOSSOCARDIA, Stolicz., 1870. Shell elongately trapezoid, sub-ventricose, concentrically striated, beaks tumescent, obtuse, close together as in Cypricardia; ligamental furrow narrow and long as in Isocardia; hinge with two cardinal and one posterior lateral tooth in each valve; the supero-posterior cardinal teeth generally are more or less distinctly bifid, at least the one in the right valve, which has anteriorly a thin, subobsolete prolongation bent downward; it is separated from the inferior cardinal and bluntly tubercular tooth by a deep sickle-shaped groove, into which fits the similarly shaped antero-inferior cardinal tooth of the left valve; this tooth is provided on the upper side with two grooves, their distance being equal to the width of the pit into which the antero-inferior tooth of the right valve fits. *C. obesa*, Reeve (cxiv, 57). Mauritius.

MICRODON, Conrad, 1842. (Cypricardella, Hall. Eodon, Hall, 1877.) Shell ovate, subelliptical, or subquadrate; concentrically striated; hinge of right valve with two cardinal teeth; the anterior tooth beneath the beaks; posterior tooth turned obliquely backwards, leaving a triangular pit, which is probably occupied by a tooth in the other valve. Anterior cardinal margin with a long narrow groove, apparently for the reception of a slender projection of the other valve; posterior side beveled from above, edge thin; ligament external, in a deep cavity; muscular scars distinct, shallow; pallial line simple. Fossil. Carboniferous; Indiana. *M. subelliptica*, Hall.

? GONIOPHORA, Phillips, 1848. Silur., Devon.; Eur., N. Am. *C. cymbæformis*, Sowb. U. Silur.; England.

CORALLIOPHAGA, Blainv., 1824.

Syn.—Lithophagella, Gray, 1847.

Distr.—5 sp. Mediterranean, in the burrows of the Lithodomus; sometimes two or three dead shells are found one within the other, besides the original owner of the cell. South Sea. Fossil; Eocene.—*C. coralliophaga*, Gmel. (cxiv, 58, 59).

Shell long, cylindrical, thin, slightly gaping behind; hinge-teeth 2·2, and a laminar posterior tooth; pallial line with a wide and shallow sinus.

ANISODONTA, Deshayes, 1860.

Distr.—2 sp. I. Bourbon. *A. complanatum*, Dh. (cxv, 64). Eocene; Paris Basin.

Shell transversely elongated, compressed, inequilateral; hinge thick; a large conical tooth and a triangular socket in each valve; ligament external. Anterior adductor scar very small, and comprised between two prominent ribs (one parallel and the

other transverse to the anterior border); posterior scar subcircular, superficial; pallial line faint, entire.

CLOTHO, Faujas, 1808. Shell oval, subequilateral; two diverging cardinal teeth in each valve. *A. Faujasii* (cxv, 65). Tertiary; Europe.

CYPRICARDINIA, Hall, 1859.

Distr.—Silurian, Devonian; New York. *C. lamellosa*, Hall (cxxi, 32).

Shell elongately trapezoidal, moderately compressed, beaks anterior or subanterior, slightly prominent, surface concentrically lamellated or striated, with a posterior more or less distinct dorsal ridge; the ligament appears to have been thin; muscular impressions ovate, slightly impressed; hinge unknown.

This is a rather unsatisfactorily known palæozoic genus; the shells have the aspect of Cypricardia, but appear to be thinner, and nothing is known of their hinge by which their proper classification could be decided.

FAMILY CARDIIDÆ.

Shell regular, equivalve, free, cordate, ornamented with radiating ribs; posterior slope sculptured differently from the front and sides; cardinal teeth two, laterals 1·1 in each valve; ligament external, short and prominent; pallial line simple or slightly sinuated behind; muscular impressions subquadrate.

Animal with mantle open in front; siphons usually very short, cirrated externally; gills two on each side, thick, united posteriorly; palpi narrow and pointed; foot large, sickle-shaped.

CARDIUM, L., 1758.

Etym.—*Kardia*, the heart. Cockle.

Distr.—100 sp. World-wide; from seashore to 140 fathoms. Gregarious on sands and sandy mud. Fossil, 330 sp. Upper Silurian—.

Shell ventricose, close or gaping posteriorly; umbones prominent, subcentral; radiately ribbed; margins crenulated; pallial line more or less sinuated.

Animal with the mantle-margins plaited; siphons clothed with tentacular filaments, anal orifice with a tubular valve; branchial fringed; foot long, cylindrical, sickle-shaped, heeled.

The cockle (*C. edule*) frequents sandy bays, near low-water; a small variety lives in the brackish waters of the river Thames, as high as Gravesend, England; it ranges to the Baltic, and is found in the Black Sea and Caspian. *C. rusticum* extends from the Icy Sea to the Mediterranean, Black Sea, Caspian and Aral. On the coast of Devon (England) the large prickly cockle (*C. aculeatum*) is eaten.

CARDIUM, restricted. (*Tropidocardium*, Römer.) Shell ventricose, subequilateral, more or less gaping behind; margin strongly dentate; valves covered with strong radiating ribs. *C. costatum*, Linn. (cxvi, 70).

BUCARDIUM, Gray. (*Pectunculus*, Adanson.) Shell globose, solid, strongly ribbed, the ribs produced on the gaping posterior margin into strong spine-like teeth. *C. ringens*, Chemn. (cxvi, 71).

TRACHYCARDIUM, Mörch. (*Granocardium*, Gabb. *Criocardium*, Conrad, 1870.) Shell oblong, inflated, a little oblique, radiately ribbed; the tops or sides of the ribs scaly spinose. *C. muricatum*, L. (cxvi, 72-74). West Indies. Fossil. Cret.; California. *Criocardium* is "Multiradiate, interstices spinose, ribs smooth; anterior lateral tooth long and prominent." *C. dumosum*, Conr. Cret.; N. Jersey. The spines originate laterally on the ribs (as is not unusual in the genus), and not between them.

ACANTHOCARDIA, Gray, 1847. (*Isocardia*, Klein.) Shell subglobose, radiately ribbed, the ribs bearing strong, sharp, curved spines. *C. aculeatum*, Linn. (cxvi, 75).

CERASTODERMA, Poli, 1791. Shell subcordiform, rounded behind; valves close, flatly ribbed; cardinal teeth strong. *C. edule*, Linn. (cxvi, 76).

PAPYRIDEA, Swains., 1840. Shell oval, oblong or transverse, thin, inequilateral; radiately ribbed, the ribs forming strong marginal teeth posteriorly. *C. hiulca*, Reeve (cxvi, 77).

FULVIA, Gray, 1847. Shell transversely oblong, very inequilateral, posteriorly produced, radiately ribbed. Differs very little from the last group. *C. bullata*, Linn. (cxvi, 78).

LYMNOCARDIUM, Stol., 1870. (*Pseudocardia* [part], Conrad, 1866. *Vetocardia* [part], Conrad, 1868.) Shell elongated, inequivalve, with the anterior side shorter, moderately inflated and rather thin, surface radiately ribbed; cardinal teeth two, or one in each valve, small, and sometimes quite obsolete, lateral teeth remote, more or less lamelliform, pallial line either entire or (rarely) sinuated, posterior gape usually distinct. Type, *Cardium Haueri*, Hörnes. The species are Tertiary; Eastern Europe, W. Asia. The type is one of the species which Conrad quotes under his genus *Pseudocardia*, the name of which the same author subsequently replaces by *Vetocardia*. When giving the characteristics of the latter, he evidently refers solely to d'Orbigny's cretaceous *Venericardiæ*, but how it was possible to associate with these forms the first named ones and others described by Hörnes from the uppermost tertiary beds of the Vienna (or rather Hungarian) Basin, it is really difficult to understand, and this the more when, after the enumeration of

the species, we find the following statement: "a genus which became extinct in the upper cretaceous period."

APHRODITA, Lea, 1834.

Syn.—Acardo, Swains. [pt.], 1840. Serripes, Beck, 1844.

Distr.—*A. Grænlandica*, Chemn. (cxvi, 79–81). Arctic seas.

Shell subcordiform, compressed, subequilateral; surface smooth or slightly radiately striate; beaks prominent; cardinal and lateral teeth obtuse, small, almost obsolete.

LÆVICARDIUM, Swainson, 1840.

Syn.—Liocardium, Mörch, 1852.

Distr.—21 sp. Universal. *L. serratum*, Linn. (cxvi, 83).

Shell oval, elongated, oblique, somewhat inequilateral; surface smooth or lightly radiately striate.

PROTOCOLDIUM, Beyrich, 1845. Posterior half of shell radiately striate, anteriorly half distantly concentrically striate. *L. lyratum*, Sowb. (cxvi, 82). There are several recent forms. *L. Hillanum*, Sowb., is a cretaceous example.

NEMOCARDIUM, Meek, 1876. Shell closely resembling the typical forms of Protocardia, but thinner, with two-thirds to three-fourths of surface in front of the stronger posterior, usually echinate, radiating costæ, occupied by fine, crowded, radiating striæ, and the free margins crenate within all around; cardinal and lateral teeth generally rather slender; pallial line faintly sinuous, irregularly serrated, or nearly simple behind. *L. semiasperum*, Desh.

PACHYCARDIUM, Conr., 1870. Shell very massive, much higher than long; valves very gibbous; hinge remarkably strong; surface sculpturing rather obscure, the posterior radiating costæ being nearly obsolete. *L. Spillmani*, Conr.

LEPTOCARDIA, Meek, 1876. Shell small, very thin, as high or higher than long; hinge weak; surface nearly smooth, the posterior radiating costæ being obsolete, or often only indicated by crenulations along the posterior third of the free margins within; pallial line with two shallow sinuses. *L. subquadratum*, Evans and Shumard.

ADACNA, Eichwald, 1838.

Syn.—Acardo, Swains. [pt.], not Brug. Hypanis, Pander.

Distr.—8 sp. Aral, Caspian, Azof, Black Sea, and the embouchures of the Wolga, Dniester, Dnieper, and Don; burrowing in mud. *A. edentulum*, Pallas (cxvi, 84).

Shell compressed, gaping behind, thin, nearly edentulous; pallial line sinuated.

Animal with the foot compressed; siphons elongated, united nearly to the end, plain. The siphonal inflection varies in amount.

The transitions between the type and the following subgenera are so gradual that the latter must be regarded as of little value.

MONODACNA, Eichw., 1838. Hinge with a single tooth. *A. Caspicum*, Eichw. (cxvi, 85).

DIDACNA, Eichw., 1838. Hinge with two teeth. *A. Donaciformis*, Schröter (cxvi, 85).

PROSODACNA, Tournouer, 1882. *A. macrodon*, Desh. Tertiary; Crimea.

HEMICARDIUM, Cuvier, 1817.

Distr.—28 sp. Tropical. *H. cardissa*, Linn. (cxvi, 87). *H. hemicardium*, Linn. (cxvi, 88).

Shell cordiform, the posterior slope strongly depressed and bordered by a carina; lunule simple; cardinal teeth distinct, more or less twisted; surface radiately ribbed.

FRAGUM, Bolten, 1798. Anterior side short and truncated; ribs tuberculated. *H. unedo*, Linn. (cxvi, 89).

CTENOCARDIA, H. and A. Adams, 1855. Like *Fragum*, but ribs spinose. *H. hystrix*, Brod. (cxvi, 90, 91).

LUNULICARDIA, Gray, 1847. Lunule depressed, surrounded by a deep broad channel; ribs nearly smooth and flattened on the posterior slope. *H. retusa*, Linn. (cxvi, 92).

CONOCARDIUM, Bronn.

Syn.—*Lychas*, Stein. *Pleurorhynchus*, Ph. *Lunulocardium*, Münster. *Arcites*, Martin.

Distr.—Fossil, 30 sp. U. Silurian — Carb.; North America, Europe. *C. aliforme*, Sowb. (cxvi, 93). *C. Hibernicum*, Sowb. (cxvii, 100).

Shell equivale-trigonal, conical and gaping in front, truncated behind, with a long siphonal tube near the umbones; anterior slope radiately, posterior obliquely striated; margins strongly crenulated within; hinge with anterior and posterior laminar teeth; ligament external.

The truncated end has usually been considered *anterior*, a conclusion which seems incompatible with the vertical position and burrowing habits of most free and equivale shells; if compared with *Adacna* the large gape will be for the foot, and the long tube siphonal. *C. Hibernicum* has an expanded keel, like *Hemicardium inversum*. The shell-structure is prismatic-cellular, as first pointed out by Sowerby; but the cells are cubical, and much larger than in any of the *Aviculadæ*. In *Cardium*, the outer layer is only corrugated or obscurely prismatic-cellular.

LITHOCARDIUM, Desh. Shell triangular, keeled; anterior side very short; hinge-teeth 1·2, directed backwards; posterior laterals 2·1; anterior muscular pit minute, posterior impression large, remote from the hinge. *L. cymbulare*, Lam., exhibits slight indications of a byssal sinus in the front margins of the

valves. Fossil. Eocene; France. *L. aviculare*, Lam. (cxvii, 1). These shells present considerable resemblance to *Tridacna*.

GOLDFUSSIA, Castelnau, 1843, is based upon *Cardium nautiloides*, each valve of which is said to resemble a laterally compressed nautilus, keeled on either side. Silurian; South America.

? DEXIOBIA, Winchell, 1863.

Distr.—Devon., Carb.; U. S. *D. ovata*, Hall.

Shell thin, inequivalve, inequilateral; beaks separated by an undefined area; right valve very ventricose, with a very prominent umbo, and a produced, incurved beak strongly inclined forward; left valve much less inflated, with a less prominent beak, scarcely elevated above the dorsal margin; hinge-line more or less extended, straight or slightly bent, edentulous? furnished with a thickened cartilage-plate bearing a lineal posterior groove; pallial line and muscular markings unknown.

CARDIOPSIS, Meek and Worthen, 1861.

Distr.—Several palæozoic species; U. S. *C. radiata*, M. and W. (cxvi, 95).

Shell equivalve, somewhat inequilateral, very slightly oblique, ovate or cordiform, entirely closed; beaks rather elevated, distinctly incurved, and directed towards the anterior side; surface marked by radiating striæ or costæ; cardinal margin short, and rounding into the posterior border; hinge provided with one or two distinct anterior teeth in each valve, near the beaks (ligament and muscular impressions unknown).

BYSSOCARDIUM, Munier-Chalmas, 1882.

Distr.—2 sp. Eocene and Miocene; France. *B. emarginatum*, Desh.

Shell allied to *Lithocardium*, but characterized by an anterior opening for a large byssus, having margins toothed like those of a *Tridacna*; anterior muscular impression very feeble, placed below the posterior cardinal tooth.

FAMILY VERTICORDIIDÆ.

Shell equivalve, or nearly so, of small size, inflated, with the beaks incurved, closed all round, more or less solid, pearly inside; hinge with few cardinal teeth, more or less obsolete, ligament subinternal or internal; two muscular impressions, pallial line simple.

The animal of *V. Japonica* has the mantle-margins united, with a small anterior opening for the protrusion of the foot, which is small, triangular, compressed, and a posterior roundish, fringed opening in which are inclosed two separated but very short siphons; labial palps small.

The curious history of the genera of this family, and of the many conflicting views of their extent and relationships, is ably given by Prof. Angelo Heilprin in Proc. Acad. Nat. Sciences, Philad., 423, 1881.

VERTICORDIA, Searles Wood, 1844.

Etym.—*Verticordia*, a name of Venus.

Syn.—Trigonulina, d'Orb.

Distr.—3 sp. China Sea, Mediterranean? Fossil, 2 sp. Miocene—; Britain, Sicily, North Carolina. *V. cardiiformis*, Wood (cxxxv, 26).

Shell suborbicular, with radiating ribs; beaks subspiral; margins denticulated; interior brilliantly pearly; hinge with one prominent cardinal tooth in each valve; adductor scars two, faint; pallial line simple; ligament internal, oblique; epidermis dark brown.

PECCHIOIA, Meneghini, 1851.

Distr.—3 sp. N. Europe. *P. argentea*, Meneg. Miocene; Europe.

Shell suborbicular, equivalve, strongly ventricose, with the beaks incurved and distant from each other, surface radiately sulcated and ribbed; hinge in the right valve with a strong cardinal tooth below the umbo, a corresponding indentation in the left valve; ligament apparently linear, situated along the upper posterior margin.

ALLOPAGUS, Stoliczka, 1870.

Syn.—Hippagus, Deshayes, non Lea.

Distr.—*Hippagus Leanus*, Deshayes (cxxvii, 60. Paris Basin.

Shell ovate, thin, very inequilateral, moderately tumid, with small approximate beaks; surface smooth with simple striæ of increase; right valve with one tooth in front of the umbo, left with a similar tooth below the umbo; ligament subinternal, posterior.

The type of this group is *Hippagus Leanus*, Deshayes. The species differs by the hinge and the structure of its shell from Hippagus, Lea's original figure of *H. isocardoides* being apparently quite correct—the latter group belonging to all appearances close to Mysia in the Ungulinidæ. Deshayes' species is externally very like a Mytilimeria, but this again accords in the character of its hinge with true Hippagus.

(Chamacea.)

FAMILY CHAMIDÆ.

Shell inequivalve, thick, attached; beaks subspiral; ligament external; hinge-teeth two in one valve, one in the other; adductor impressions large, reticulated; pallial line simple.

Animal with the mantle closed; pedal and siphonal orifices small, subequal; foot very small; gills two on each side, very unequal, united posteriorly.

CHAMA (Pliny), Linn.

Distr.—50 sp. Tropical seas, especially amongst coral reefs; fifty fathoms. West Indies, Canaries, Mediterranean, India, China. Fossil, 40 sp. Cret.—; United States, Europe. *C. lazarus*, Linn. (cxvi, 98).

Shell attached usually by the left umbo; valves foliaceous, the upper smallest; hinge-tooth of free valve thick, curved, received between two teeth, in the other; adductor impressions large, oblong, the anterior encroaching on the hinge-tooth.

Animal (cxvii, 3, 4) with the mantle-margins united by a curtain, with two rows of tentacular filaments; siphonal orifices wide apart, branchial slightly prominent, fringed, anal with a simple valve; foot bent, or heeled; liver occupying the umbo of the attached valve only; ovary extending into both mantle-lobes, as far as the pallial line; lips simple, palpi small and curled; gills deeply plaited, the outer pair much shorter and very narrow, furnished with a free dorsal border, and united behind to each other, and to the mantle; adductors each composed of two elements.

The shell of Chama consists of three layers; the external, colored layer is laminated by oblique lines of growth, with corrugations at right-angles to the laminae; the foliaceous spines contain reticulated tubuli; the middle layer is opaque white, and consists of ill-defined vertical prisms or corrugated structure; the inner layer, which is translucent and membranous, is penetrated by scattered vertical tubuli; the minute processes that occupy the tubuli give to the mantle (and to the casts of the shell) a granular appearance.

Some Chamas are attached indifferently by either valve; when fixed by the right valve the dentition is reversed, the left valve having the single tooth.

ARCINELLA, Schumacher, 1817. Shell nearly regular and equi-valve, ribbed and spiny, with a distinct lunule, attached by the right valve. *C. arcinella*, Linn. (cxvi, 99). The subgenus is scarcely warranted by its distinctive characters. Like most attached shells, the Chamae are very irregular in form and sculpture; the same species may be simply ribbed, or foliated, or spinose, according to circumstances. The consequence of this variability has been an undue multiplication of species.

MONOPLEURA, Matheron, 1842.

Distr.—Fossil, 10 sp. Neocomian—Chalk; France, Texas. *M. Urgonensis*, Matheron (cxvii, 2).

Shell attached by the dextral umbo; valves alike in structure and sculpturing; fixed valve straight, inversely conical, with a long, straight ligamental groove, and obscure hinge-area; opercular valve flat or convex, with an oblique, submarginal umbo.

They are commonly found in groups, adhering laterally, or rising one above the other; the casts of such as are known are quite simple and Chama-like.

VALLETIA, Munier-Chalmas, 1872. *V. Tombecki*, M.-Ch. Neocomian; Savoy.

DICERAS, Lamarck, 1804.

Syn.—Heterodicerias, Munier-Chalmas. Pseudodicerias, Gemmellaro.

Distr.—5 sp. Middle Oolite; Germany, Switzerland, France, Algeria. *D. arietinum*, Lam. (cxvii, 5-7).

Shell subequivalve, attached by either umbo; beaks very prominent, spiral, furrowed externally by ligamental grooves; hinge very thick, teeth 2.1, prominent; muscular impressions bounded by long spiral ridges, sometimes obsolete.

Dicerias differs from Chama in the great prominence of both its umbones, in having constantly two hinge-teeth in the right valve and one in the left, and in the prominent ridges bordering the muscular impressions. Similar ridges exist in Cucullæa, Megalodon, Cardilia, and Hippurites; they produce deep spiral furrows on the casts, which are of common occurrence in the Coral-oolite of the Alps. One or both the anterior furrows are frequently obsolete. The dental pits are much deeper than the teeth which they receive, and are subspiral, giving rise to bifid projections on the casts; the single tooth in the left valve consists of two elements, and the cavity (fosset) which receives it is divided at the bottom.

Munier-Chalmas divides Dicerias thus:

DICERAS, Lam., 1805. Posterior muscular impression on a plate, more or less elevated, the anterior upon plate-like ridges. *D. arietinum*, Lam.

HETERODICERAS, Munier-Chalmas, 1869. Posterior impression in each valve upon horizontal or concave surfaces, connected to the cardinal plate, anterior impression upon similar surfaces, more or less horizontal. *D. Lucii*, Defrance.

PLESIODICERAS, Munier-Chalmas, 1882. Postero-cardinal tooth more or less prolonged anteriorly, and reversed behind; posterior muscle advancing a little between the cardinal margin and the base of the postero-cardinal tooth. *D. Valfinense*, Boehm.

BAYLEIA, Munier-Chalmas, 1872. One valve resembling Dicerias by its raised plate for the muscular impression, the other approaching caprinoid groups by its beak and by the two cavities

for the insertion of the anterior muscle. *D. Pouechi*, Munier-Chalmas. Cret.; France.

REQUIENIA, Matheron, 1842.

Dedicated to M. Requien, author of a Catalogue of Corsican Mollusca.

Distr.—Fossil, 7 sp. Neocomian—L. Chalk; Britain, France, Spain; Algeria, Texas. *R. Lonsdalii*, Sowb. (cxvii, 8, 9, 12). *R. ammonia*, (cxvii, 10, 11).

Shell thick, very inequivalve, attached by the left umbo; ligament external; teeth 2·1; left valve spiral, its cavity deep, not concamerated; free valve smaller, subspiral; posterior adductor bordered by a prominent subspiral ridge in each valve.

The shell-structure of Requienia is like Chama. The relative size of the valves is subject to much variation; in *R. Favri* (Sharpe) they are nearly equal. The hinge-teeth are like those of Diceras; the cavity for the posterior tooth of the right valve is very deep and subspiral. The internal muscular ridges are produced by duplicatures of the shell-wall, and are indicated outside by grooves. In *R. subæqualis* and *Toucasiana* there is a second parallel ridge, as in Hippurites and Caprotina.

The following uncharacterized groups are probably not very distinct from Requienia.

TOUCASIA, Munier-Chalmas, 1873. *T. carinata*, Matheron. Urgonian.

MATHERONIA, Munier-Chalmas, 1873. *M. Virginia*, Sc. Urgonian.

ETHRA, Matheron. *E. Munieri*, Math. Urgonian.

CAPRINA, C. d'Orbigny, 1823.

Etym.—*Caprina*, pertaining to a goat.

Syn.—Sphærucaprina, Gemm. Plagioptychus, Matheron, 1842. Gemmellaria, Munier-Chalmas.

Distr.—Fossil, 10 sp. Upper Greensand and Lower Chalk; Bohemia, France, Texas.

Shell with dissimilar valves, with subspiral beaks; fixed valve conical, marked only by lines of growth and a ligamental groove; hinge-margin with several deep cartilage-pits; and one large and prominent tooth on the posterior side; free valve oblique or spiral, thick, perforated by one or more rows of flattened canals, radiating from the umbo and opening around the inner margin; anterior tooth supported by a plate which divides the umbonal cavity lengthwise, posterior tooth obscure; hinge-margin much thickened, grooved for the cartilage.

In *C. adversa* (cxvii, 13; cxviii, 19) the free valve is sinistrally spiral; its cavity is partitioned off by numerous septa, and divided longitudinally by the dental plate. When young it is attached by the apex of the straight valve, but afterwards

becomes detached, as the large specimens are found imbedded with the spire downwards.—**SAEMANN.**

LYCODYS, Schafhaeutl, 1863. Shell inequivalve, oblong, moderately tumid, with large incurved and rather approaching beaks; of solid structure and concentrically costate. In the place of the hinge there seems to be in the left valve a large hinge-plate, the anterior portion of which is partially elevated and prolonged into a transverse tooth, and the posterior depressed, probably for the reception of the tooth of the other valve. From the posterior part a rib runs internally up to the umbones, and there is also a posterior elongated tooth present almost parallel to the margin of the shell. One species, *L. cor*, is figured and described from an Alpine limestone bed, probably lower secondary.

CAPROTINA, d'Orbigny, 1842.

Distr.—Fossil, 10 sp. Upper Greensand; France. *C. striata*, d'Orb. (cxvii, 14, 15). *C. quadripartita* (cxviii, 21).

Shell composed of two distinct layers; valves alike in structure, dissimilar in sculpturing; ligamental groove slight; cartilage internal; right valve fixed, striated or ribbed, with one narrow tooth between two deep pits, several pits on each side of the ligamental inflection, posterior adductor supported by a plate; free valve flat or convex, with a marginal umbo; teeth two, very prominent, supported by ridges (apophyses) of the adductor muscles, the anterior tooth connected with a third plate which divides the umbonal cavity.

The smaller Caprotinæ occur in groups, attached to oyster-shells; their muscular ridges are much less developed than in the large species. *C. costata* is like a little Radiolite.

CAPRINELLA, d'Orbigny, 1847.

Syn.—Caprinula (*Boissii*), d'Orbigny, 1847. Ichthyosarcolithes, Desm. ? Chaperia, Mun.-Chal., 1873.

Distr.—Fossil, 6 sp. Cretaceous; France, Portugal, Sicily. *C. Aiguilloni* (cxviii, 18).

Shell fixed by the apex of the right valve, or free; composed of a thick layer of open tubes, with a thin compact superficial lamina; cartilage internal, contained in several deep pits; umbones more or less cambered; right valve conical or elongated, with a ligamental furrow on its convex side, and furnished with one strong hinge-tooth supported by an oblique plate; left valve oblique or spiral, with two hinge-teeth, the anterior supported by a plate which divides the umbonal cavity lengthwise.

In *C. triangularis*, Desm. (cxviii, 22, 23), the umbonal cavity of the spiral valve is partitioned off at regular intervals; the length of the water-chambers is sometimes $3\frac{1}{2}$ inches, and of

the body-chamber from 2 to 7 diameters; specimens measuring a yard across may be seen on the cavernous shores of the islets near Rochelle.—PRATT.

CHAMOSTREA, Roissy, 1805.

Syn.—Cleidothærus, Stutch., 1829.

Distr.—1 sp. New South Wales. *C. albida*, Lam. (cxvii, 16, 17).

Shell inequivalve, Chama-shaped, solid, attached by the anterior side of the deep and strongly-keeled dextral valve; umbones anterior, subspiral; left valve flat, with a conical tooth in front of the cartilage; cartilage internal, with an oblong, curved ossicle; muscular impressions large and rugose, the anterior very long and narrow; pallial line simple.

Animal with mantle-lobes united by their extreme edge between the pedal orifice and siphons; pedal opening small, with a minute ventral orifice behind it; siphons a little apart, very short, denticulated; body oval, terminating in a small, compressed foot; lips bilobed, palpi disunited, rather long and obtusely pointed; gills one on each side, large, oval, deeply plaited, prolonged in front between the palpi, united posteriorly; each gill traversed by an oblique furrow, the dorsal portion consisting of a single lamina with a free margin.

FAMILY HIPPURITIDÆ.

(Order Rudistes, Lamarek.)

Shell inequivalve, unsymmetrical, thick, attached by the right umbo; umbones frequently camerated; structure and sculpturing of valves dissimilar; hinge-teeth 1·2; adductor impressions two, large, those of the left valve on prominent apophyses.

The shells of this extinct family are characteristic of cretaceous strata, and abound in many parts of the Peninsula, the Alps, and Eastern Europe, where the equivalent of the Lower Chalk has received the name of "Hippurite limestone." They occur also in Turkey and in Egypt, and Dr. F. Römer has found them in Texas and Guadaloupe. The structure of these shells has been fully described in the Quarterly Journal of the Geological Society of London. In all the genera the shell consists of three layers, but the outermost, which is thin and compact, is often destroyed by the weathering of the specimens. The principal layer in the lower valve of Hippurites is not really very different from the upper valve in structure; the laminae are corrugated, leaving irregular pores, or tubes, parallel with the long axis of the shell, and often visible on the rim. The umbo of the upper valve of Radiolites is marginal in the young shell.

They are the most problematic of all fossils; there are no recent shells which can be supposed to belong to the same family; and the condition in which they usually occur has involved them in greater obscurity. The characters which determine their position amongst the ordinary bivalves are the following:—

1. The shell is composed of three distinct layers.
2. They are essentially unsymmetrical, and right-and-left valved.
3. The sculpturing of the valves is dissimilar.
4. There is evidence of a large internal ligament.
5. The hinge-teeth are developed from the free valve.
6. The muscular impressions are two only.

The outer layer of shell in *Radiolites* consists of prismatic cellular structure; the prisms are perpendicular to the shell-laminæ, and often minutely subdivided. The cells appear to have been empty, like those of *Ostrea*. The inner layer, which forms the hinge and lines the umbones, is subnacreous, and very rarely preserved. It is usually replaced by calcareous spar, sometimes by mud or chalk, and very often it is only indicated by a vacuity between the outer shell and the internal mould. The inner shell-layer is seldom compact, its lamellæ are extremely thin, and separated by intervals like the water-chambers of *Spondylus*; similar spaces occur in the deposit, filling the umbonal cavity of the long-beaked oysters.

The chief peculiarity of the Hippuritidæ is the dissimilarity in the structure of the valves, but even this is deprived of much significance by its inconstancy. The free valve of *Hippurites* is perforated by radiating canals which open round its inner margin, and communicate with the upper surface by numerous pores, as if to supply the interior with filtered water; possibly they were closed by the epidermis. In the closely allied genus *Radiolites* there is no trace of such canals.

The teeth of the left, or upper, valve are so prominent and straight, that its movement must have been nearly vertical, for which purpose the internal ligament appears to have been exactly suited by its position and magnitude; but it is probable that, like other bivalves, they opened to a very small extent.

HIPPURITES, Lamarek, 1801.

Etym.—Adopted from old writers, “fossil Hippuris,” or Horse-tail. *Syn.*—Batolites, Raphanistes, Montf.

Distr.—Fossil, 30 sp. Chalk; Bohemia, Tyrol, France, Spain, Turkey, Syria, Algeria, Egypt. *H. toucasianus* (cxviii, 27, 28). *H. sulcatus*, DeFrance (cxviii, 29, 30).

Shell very inequivalve, inversely conical, or elongated and cylindrical; fixed valve striated or smooth, with three parallel

furrows on the cardinal side, indicating duplicatures of the outer shell-layer; internal margin slightly plaited; umbonal cavity moderately deep, ligamental inflection with a small cartilage-pit on each side; dental sockets subcentral, divided by an obsolete tooth; anterior muscular impression elongated, double, posterior small, very deep, bounded by the second duplicature; third duplicature projecting into the umbonal cavity; free valve depressed, with a central umbo, and two grooves or pits corresponding to the posterior ridges in the lower valve; surface porous, the pores leading to canals in the outer shell-layer, which open round the pallial line upon the inner margin; anterior cartilage-pit deep and conical, posterior shallow; umbonal cavity turned to the front; teeth two, straight, subcentral, the anterior largest, each supporting a crooked muscular apophysis, the first broad, the hinder prominent, tooth-like; inflections surrounded by deep channels.

H. cornu-vaccinum (cxvii, 18, 19; cxviii, 24) attains a length of more than a foot, and is curved like a cow's horn; the outer layer separates readily from the core, which is furrowed longitudinally. The ligamental inflection is very deep and narrow, and the anterior tooth farther removed from the side than in *H. bioculatus* and *radiosus* (cxviii, 25, 26); the posterior apophysis does not nearly fill the corresponding cavity in the lower valve. In *H. bioculatus* and some other species there is no ligamental ridge inside; these, when they have lost their inner layer, present a cylindrical cavity, with parallel ridges extending down one side. The third inflection is possibly a siphonal fold, such as exists in the tube of *Teredo*, and sometimes in the valves of *Pholas*, *Clavagella*, and the caudate species of *Trigonia*.

The development of processes from the upper valve, for the attachment of the adductor muscles, harmonizes with the other peculiarities of Hippurites. The equal growth of the margins of the valves produces central umbones, and necessitates an internal cartilage; this again causes the removal of the teeth and adductors farther from the hinge-margin, to a position in which the muscles must have been unusually long, unless supported in the manner described. Supposing the animal to have had a small foot, like *Chama*, the mantle-opening for that organ would have been completely obstructed by the adductor, but that the muscular support was hook-shaped. The posterior adductor-process is similarly under-cut for the passage of the rectum, which in all bivalves emerges between the hinge and posterior adductor, winds round outside that muscle, and terminates in the line of the exhalent current. There is a groove (sometimes an inch deep) round the second and third duplicatures in the upper valve, which seems intended to facilitate the passage of the alimentary canal, and the flow of water from the

gills into the exhalent channel. The smallness of the space for the branchiæ may have been compensated by deep plication of those organs, as in *Chama* and *Tridacna*.

HIPPURITES (restricted). Hinge-rib well-developed. *H. cornu-vaccinum*, Bronn.

D'ORBIGNYA, Woodward, 1862. "No ligamental inflection of the outer shell." Doubtfully distinct. Fossil, 4 sp. Middle Chalk; Europe. *H. bioculatus*, Lam.

BARRETTIA, Woodward, 1862. Dedicated to Mr. Lucas Barrett, late Director of the Geological Survey of the West Indies. No "ligamental inflection" as in d'Orbigny, but it presents the further peculiarity of an indefinite number of pallial duplicatures extending all round the margin of the lower valve. Type, *B. monilifera*, Woodward. "Hippurite limestone." Jamaica. This is a doubtful group; its pertinence to the genus, and even to mollusca, has been questioned.

PIRONÆA, Meneghini, 1868. Shell strongly ribbed; the hinge-lamina short and thick. *H. organisans*, Mont.

RADIOLITES, Lamarck, 1801.

Etym.—*Radius*, a ray.

Distr.—Fossil, 42 sp. Neocomian—Chalk; Texas, Britain, France, Bohemia, Saxony, Portugal, Algeria, Egypt. *R. alata*, d'Orb. (cxviii, 31). *R. mamillaris*, Math. (cxviii, 32–35). *R. Hoeninghausii* (cxviii, 36, 37).

Shell inversely conical, biconic, or cylindrical; valves dissimilar in structure; internal margins smooth or finely striated, simple, continuous; ligamental inflection very narrow, dividing the deep and rugose cartilage-pits; lower valve with a thick outer layer, often foliaceous; its cavity deep and straight, with two dental sockets and lateral muscular impressions; upper valve flat or conical, with a central umbo; outer layer thin, radiated; umbonal cavity inclined towards the ligament; teeth angular, striated, supporting curved and subequal muscular processes.

The upper valve of *R. fleurbaeus* has an oblique umbo, with a distinct ligamental groove. The foliations of the lower valve are frequently undulated; they are sometimes as thin as paper, and several inches wide.

The umbonal cavity of the lower valve is partitioned off by very delicate funnel-shaped laminae. Specimens frequently occur in which the outer shell-layer is preserved, whilst the inner is wanting, and the mould ("birostrites") remains loose in the centre. The interior of the outer shell-layer is deeply grooved with lines of growth, and exhibits a distinct ligamental ridge in each valve.

In aged examples of *R. calceoloides* the ligamental inflection is concealed, the cartilage-pits partially filled up and smoothed,

and the teeth and apophyses so firmly wedged into their respective cavities as to suggest the notion that the valves had become fixed about a quarter of an inch apart, and ceased to open and close at the will of the animal.

BIRADIOLITES, d'Orbigny, 1850. Ligamental groove visible in one or both valves, sometimes occupying the crest of a ridge, and bordered by two similar areas. Fossil, 5 sp. Chalk; France. *R. canaliculatus* (cxviii, 38).

LAPEIROUSIA, Bayle. *R. Jouanetti*, Desm.

SYNDONITES, Pirona, 1869. Cardinal teeth grown together almost in their entire length. *R. Stoppaniana*, Pir. Cret.; Friaul.

SPHÆRULITES, de la Merthe, 1805. (Acardo, Brug. Iodamia, Defrance. Birostrites, Lam. Dipilidia and Agria, Math. Heterocaprina, Munier-Chalmas.) Attached valve generally elongately conical with longitudinal, more or less foliated surface and the margins radiately ribbed, internally with a single umbonal rib extending the whole length of the valve. Free valve smaller, similar in form and structure to that of Radiolites, but with a median tooth or columella corresponding to the hinge-rib of the other valve, in which there is on each side of the rib a cartilage-process, the two cartilage-plates being sometimes united in front, and next to them are situated the raised muscular scars. *R. unisulcatus*, Matheron (cxviii, 39).

The presence of a hinge-rib readily distinguishes the present group from Radiolites (restricted), and the absence of any other ribs or folds in the attached valve separates it from Hippurites.

TAMIOSOMA, Conrad, 1856.

The type of this genus is a very peculiar fossil from the upper miocene deposits of California, *T. gregaria*, Conn. Gabb, in the second volume of the Palæontology of California (pp. 61-63), has very ably discussed the organization of this fossil, and comes to the conclusion that it is most likely a species of the Hippuritidæ. The specimens which have, up to the present, been found, resemble the elongated, lower valve of Hippurites with a small place of attachment apparently at the thinner or lower end. They are subcylindrical with rather thick walls consisting of two or three layers, possessing the same reticulated and striated structure as that of Radiolites, and others. The lower portion of the shell is composed of a large number of irregular chambers or septa which are produced by lateral prolongations of the inner wall. The end is occupied by a large cavity, similar to the "body-chamber" of Hippurites, but no impressions of teeth have as yet been observed in it. The outer surface is longitudinally striated in the type species which grows in clusters, as does, for instance, *H. organisans*, DeFr.

In some respects Tamiosoma recalls the organization of the peculiar Hippurite from Jamaica, called by Woodward, Barrettia.

FAMILY MEGALODONTIDÆ.

Shell equivalve, very thick, mostly smooth or finely concentrically striated; hinge-plate broad and thick, with two strong teeth in each valve—sometimes bipartite; ligament external, supported by thick fulera; posterior muscular impression usually upon a prominent ridge.

MEGALODON, J. Sowerby.

Etym.—*Megas*, large; *odos*, tooth.

Syn.—*Megalodus*, Goldfuss. *Tauroceras*, Schafh.

Distr.—Fossil, 14 sp. Upper Silurian—Devonian; United States, Europe. *M. cucullatus*, Sowb. (cxxxii, 41).

Shell oblong, smooth or keeled; ligament external; hinge-teeth 1·2, thick; laterals 1·1, posterior; anterior adductor impression deep, with a raised margin, and a small pedal scar behind it.

In the typical species the beaks are subspiral, the lateral teeth obscure, and the posterior adductors bounded by prominent ridges.

[MEGALOMUS (*Canadensis*), Hall, 1852. Umbones very thick, hinge-teeth rugged, almost obliterated with age; posterior lateral teeth 1·1; no muscular ridges. Upper Silurian; Canada.]

EUMEGALODON, Gümbel, 1862. Shell elongated, sometimes longitudinally carinated; posterior cardinal tooth in the right valve smaller and widely bifid, corresponding tooth in the left valve very prominent and only grooved, posterior lateral tooth well-developed. *M. cucullatus*, Sowb.

NEOMEGALODON, Gümbel, 1862. Shell subtrigonal or cordiform, posterior cardinal teeth bifid in both valves, stronger in the left than in the right one, posterior lateral tooth indistinct or obsolete. Triassic. *M. triqueta*, Walfen.

PACHYMEGALODON, Gümbel, 1862. Posterior cardinal tooth single in the left, double and curved in the right valve, posterior lateral tooth short and distinct; anterior muscular impression posteriorly and inferiorly surrounded by a raised margin. Triassic. *M. chamæformis*, Gümbel.

PACHYRISMA, Morris and Lycett.

Etym.—*Pachus*, thick; *ereisma*, support.

Type, *P. grande*, Morris and Lycett (cxii, 39, 40). Great Oolite (Bathonian); Minchinhampton.

Shell cordate, with large subspiral beaks; valves very thick near the umbones, obliquely keeled; hinge with one thick conical tooth (behind the dental pit, in the right valve), a small lateral tooth close to the deep and oval anterior adductor, and a posterior lateral tooth (or muscular lamina?); ligamental plates short and deep.

CONCHODON, Stoppani, 1865.

Etym.—*Conchos*, a shell, and *odos*, a tooth.

Type, *C. infraliasicus*, Stop. Lower Lias; Lombardy.

Shell equivalve, symmetrical, very thick, cordiform, closed; beaks large, angulated, involute. Ligament internal, very long, marginal, attached to the posterior half of the hinge-plate. Hinge massive; in the right valve, one large rounded tooth in front (placed above a dental pit), and two transverse cardinal teeth; left valve with a large circular socket, bounded below by a curved lamellar tooth; two transverse and one curved teeth beneath the umbo.

DICEROCARDIUM, Stoppani, 1865.

Etym.—*Diceras*, having two horns, and *cardium*.

Distr.—Fossil, 4 sp. Upper Trias; Lombardy, Northwest Himalayas. *D. Jani*, Stop. (cxvii, 20, 21).

Shell equivalve, symmetrical, closed, free; umbones very prominent, elongated, or spiral. Hinge-plate broad, thick, separated by an interval of varying width from the edge of the valve, and prolonged into the umbonal cavity. Left valve with a compressed cardinal tooth, corresponding to a socket in the right valve; valves furrowed by ligamental grooves. Ligament external.

FAMILY TRIDACNIDÆ.

Shell regular, equivalve, truncated in front; ligament external; valves strongly ribbed, margins toothed; muscular impressions blended, subcentral, obscure.

Animal attached by a byssus, or free; mantle-lobe extensively united; pedal opening large, anterior; siphonal orifices surrounded by a thickened pallial border; branchial plain; anal remote, with a tubular valve; shell-muscle single, large and round, with a smaller pedal muscle close to it behind; foot finger-like, with a byssal groove; gills two on each side, narrow, strongly plaited, the outer pair composed of a single lamina, the inner thick, with margins conspicuously grooved; palpi very slender, pointed.

The shell of *Tridacna* is extremely hard, being calcified until almost every trace of organic structure is obliterated.

TRIDACNA, Bruguière, 1789.

Etym.—*Tri*, three; *dakno*, to bite; a kind of oyster. (Pliny.) Clam-shell.

Syn.—*Chametrachæa*, Klein, 1753.

Distr.—7 sp. Indian Ocean, China Seas, Pacific. Fossil, *T. media*. Miocene; Poland. *Tridacna* and *Hippopus* are found in the raised coral-reefs of Torres Straits. (Macgillivray.) *T. squamosa*, Lam. (cxxxviii, 86–88). *T. crocea*, Lam. (cxxxviii, 91).

Shell massive, trigonal, ornamented with radiating ribs and imbricating foliations; margins deeply indented; byssal sinus in each valve large, close to the umbo in front; hinge teeth 1·1, posterior laterals 2·1.

A pair of valves of *T. gigas*, weighing upwards of 500 pounds and measuring about two feet across, are used as benitiers in the Church of St. Sulpice, Paris. (Dillwyn.) Captain Cook states that the animal of this species sometimes weighs twenty pounds, and is good eating.

Axes of great size, weighing seven or eight pounds, are made from the thickest portion of the giant Tridacna by the natives of the Caroline Islands.—DR. J. C. COX.

HIPPOPUS, Lamarck, 1799. The “bear’s-paw clam” has close valves with two hinge-teeth in each. It is found on the reefs in the Coral Sea. The animal spins a small byssus. *H. maculatus*, Lam. (cxxxviii, 89–90).

EURYDESMA, Morris, 1845.

Distr.—*E. cordata*, Sowb. Devonian? N. So. Wales.

Shell oval or roundly cordate, rather thin, but very much thickened near the beaks, concentrically striated or nearly smooth; beaks strongly incurved, with a sort of an excavated and gaping lunette in front; ligament large, occupying the greater part of the posterior, more or less straight hinge-area, which is broad and extends below the beaks so as to make the ligament almost internal, one large subconical cardinal tooth in the right valve somewhat curved upward and corresponding to a pit in the left; several small muscular impressions near the hinge, but no other larger ones perceptible, neither has the pallial impression been as yet traced out.

(*Lucinacea*.)

FAMILY LUCINIDÆ.

Shell orbicular, free, closed; hinge-teeth 1 or 2, laterals 1—1 or obsolete; interior dull, obliquely furrowed; pallial line simple; muscular impressions two, elongated, rugose; ligament external or subinternal.

Animal with mantle-lobes open below, and having one or two siphonal orifices behind; foot elongated, cylindrical, or strap-shaped (ligulate), protruded at the base of the shell; gills one (or two) on each side, large and thick, oval; mouth and palpi usually minute.

The Lucinidæ are distributed chiefly in the tropical and temperate seas, upon sandy and muddy bottoms, from the seashore to the greatest habitable depths. The shell consists of two distinct layers. The family first appeared in the Silurian.

SUBFAMILY LUCININÆ.

Shell more or less orbicular, the anterior muscular impression narrower and much longer than the posterior, the ligament is lodged in a deep groove or is sometimes nearly internal.

LUCINA, Bruguière, 1792.

Etym.—*Lucina*, a name of Juno.

Distr.—100 sp. Universal. Fossil, 250 sp. U. Silurian—; United States, T. del Fuego, Europe, Southern India. *L. Jamaicensis*, Linn. (cxix, 40).

Shell orbicular, white; umbones depressed; lunule distinct; margins smooth or minutely crenulated; ligament oblique, semi-internal; hinge-teeth 2-2, laterals 1—1 and 2—2, or obsolete; muscular impressions rugose, anterior elongated within the pallial line, posterior oblong; umbonal area with an oblique furrow.

Animal with the mantle freely open below; siphonal orifices simple; mouth minute, lips thin; gills single on each side, very large and thick; foot cylindrical, pointed, slightly heeled at the base.

The foot of *Lucina* is often twice as long as the animal, but is usually folded back on itself and concealed between the gills; it is hollow throughout.

CYCLAS, Klein, 1753. (*Divaricella*, von Martens, 1880.) Valves divaricately striate *L. divaricata*, Lam. (cxix, 41). West Indies. *L. Rigaultiana*, Desh., a fossil of the Paris Basin, may also be added to this group.

CODAKIA, Scopoli, 1777. (*Lentillaria*, Schum., 1817. *Jaconia*, Recluz, 1869.) Shell flattened, surface radiately flatly ribbed or grooved. *L. tigerina*, Linn. (cxix, 42).

MILTHA, H. and A. Adams, 1856. Shell inequivalve, with nearly smooth surface; lateral teeth obsolete. *L. Childreni*, Gray (cxix, 43).

MYRTEA, Turton, 1822. (*Cyrachæa*, Leach.) Shell a little compressed, ribbed, crossed by scabrous concentric lines. Cardinal teeth one in one valve, two in the other. *L. scabra*, Lam. (cxix, 44, 45).

HERE, Gabb. Shell suborbicular, globose, concentrically striated, anterior lateral and cardinal teeth well developed, as in *Lucina*, but the lunule is very deep, extending across the hinge-area between the anterior lateral and the cardinal teeth. *L. Richthofeni*, Gabb (cxix, 46, 53). Tertiary; California. Two recent California species are included by Mr. Gabb in this group, the main character of which is the excavation of the lunule.

PARACYCLAS, Hall, 1843. May be a section of *Lucina*, but its hinge and other internal characters are unknown. 5 sp. Devonian; N. Y.

LORIPES, Poli, 1791.

Etym.—*Lorum*, a strap; *pes*, a foot.

Syn.—Lucinidea, d'Orb. Glissocolus, Gabb, 1869.

Distr.—25 sp. Atlantic, Mediterranean, West Indies. Fossil. Eocene—; France. Cret.; California. *L. edentula*, Linn. (cxix, 47).

Animal with the margin of the mantle notched; incurrent tube long.

Shell almost equilateral, cancellated, or sculptured by flexuous striæ; lunule short; cartilage *quite internal*; teeth, one cardinal in the right, and two in the left valve; laterals remote, and sometimes indistinct.

AUSTRIELLA, Tenison-Woods, 1881. A rounded-oval shell, with concentric lamellæ, covered by a brown epidermis which extends over the interior side around the margin, forming a broad band; hinge thick, with an inconspicuous arcuate smooth tooth; interior surface white with radiating obsolete ribs, not nacreous, without pallial sinus.

A. sordida, Tenison-Woods. Port Denison, Australia, in fresh- or brackish-water swamps. This shell was supposed by the describer to belong to the family Unionidæ, and to be closely allied to *Spatha*, but it is evident he is not acquainted with the latter genus. Judging from the description and figure it appears to me to be a Lucinoid shell, closely allied to if not identical with *Loripes*.

CRYPTODON, Turton, 1822.

Syn.—*Axinus*, J. Sowerby, 1823. *Thysaira*, etc., Leach. *Bequania*, Leach. *Ptychina*, Philippi, 1836. *Thiatyra*, G. Sowb.

Distr.—16 sp. Europe, etc. Fossil, 3 sp. Eocene; United States, Europe. *C. flexuosus*, Montf. (cxix, 48).

Animal with the mantle-margin thickened, open, not prolonged into tubes; foot long, subcylindrical, and very slender.

Shell globular, posterior side furrowed or angulated, umbones much recurved; lunule short or indistinct; ligament usually and to a certain extent external, placed in a groove on the hinge-line, and outside the hinge-plate; teeth altogether wanting.

In *C. flexuosus*, the hinge-plate is indented in the right valve immediately below the beaks, and slightly reflected in the left, which gives that valve the appearance of having an indistinct or obscure cardinal tooth.

PHILIS, Fischer, 1864.

Distr.—*P. Cumingii*, Fischer (cxix, 49, 50). Moluccas.

Shell ovate, higher than long, inflated, thin, finely concentrically striated and with a posterior duplicature extending from the beaks; hinge edentulous, lunula small and very deep, forming a

kind of a roundish or spoon-shaped process below the beaks; muscular impressions rounded.

SUBFAMILY CORBINÆ.

Shell generally elongately ovate, or ovately rounded, solid, with muscular impressions subequal, broadly ovate, the ligament always external.

CORBIS, Cuvier, 1817.

Etym.—*Corbis*, a basket.

Syn.—*Fimbria*, Mühl., 1811, not Bohadsch. *Idotæa*, Schum., 1817. *Gafrarium*, Bolten, 1798.

Distr.—5 sp. India, China, North Australia, Pacific. Fossil, 80 sp. (including subgenera). Lias—; United States, Europe. *C. fimbriata*, Linn. (cxix, 51).

Shell oval, ventricose, subequilateral, concentrically sculptured; margins denticulated within; hinge-teeth two, laterals two, in each valve; pallial line simple; umbonal area with an oblique furrow, muscular impressions round and polished; pedal scars close to adductors.

Animal with the mantle open below, doubly fringed; foot long, pointed; siphonal opening single, with a long retractile tubular valve; lips narrow; palpi rudimentary; gills single on each side, thick, quadrangular, plaited, united behind.

In *C. dubia* (Semicorbis), Desh., from the Eocene, Paris, the lateral teeth are obsolete.

SPHÆRA, Sow., 1822. (*Palæocorbis*, Conrad, 1869.) Shell ovate, inflated, solid, subequilateral; hinge of left valve with two blunt cardinal teeth, the posterior much smaller and separated from the larger anterior by a pit; lunular edge somewhat extended with a deep pit and a swollen tooth-like margin above and below it; posteriorly with a furrow near the fulcral margin and several cross-teeth at the posterior end; ligament in a long excavated furrow. Type, *C. corrugata*, Sowb. (cxix, 52. Neocomian

MUTIELLA, Stolicz., 1870. Shell oblong, subequilateral, tumid, with obtuse incurved beaks; hinge in the left valve with two cardinal teeth, the anterior one being sometimes bifid, in the right valve there is a single large bifid cardinal tooth; lunular edge expanded, with several teeth, or with more or less distinct corrugations, representing anterior lateral tooth; posterior hinge side straight with a furrow near the margin for the ligament, and an indistinct terminal posterior lateral tooth. *C. coarctata*, Zitt. (cxix, 56, 57). This group differs essentially by the characters of the hinge from the previous; there are several middle and upper cretaceous species which belong to it, but none are known from more recent deposits.

SPHÆRIOLA, Stoliczka, 1870. Shell rounded, globose, nearly equilateral, with concentric striæ or sulci on the surface; hinge

with two diverging cardinal teeth in each valve, the anterior being somewhat elongated and nearly horizontally extended. The absence of lateral teeth and the usual rounded and globose form readily distinguishes this group from *Corbis*. The group has been mistaken for *Sphæra*, under which name also most of the species appear to have been described. Triassic, Cretaceous. *C. Mellingi*, Hauer (cxix, 54, 55).

UNICARDIUM, d'Orbigny, 1852.

Syn.—*Mactromya*, Agass. (part).

Distr.—Jurassic and Cretaceous. *U. impressum*, Morris and Lycett (cxix, 58).

Shell transversely oval, smooth or concentrically striate; hinge with a single cardinal tooth in each valve, and no lateral teeth.

GNODON, Schafhaeutl, 1863. Shell ovate, tumid, apparently smooth; hinge of the right valve with a very large median semi-circular broad tooth with the sharpened edge turned upwards, that of the left valve with an equally large corresponding pit below bounded by a long thick tooth somewhat smaller than that of the other valve; the posterior margins of the hinge are thickened in both valves. This group differs from *Unicardium* by the enormous development (natural?) of the teeth. Type, *U. ovatum*, Goldfuss. Lias.

CONCHOCELE, Gabb, 1866.

Type, *C. disjuncta*, Gabb. Tertiary; California.

Shell subquadrate, posteriorly less high and elongated, being very inequilateral, a ridge passing from the beaks to the posterior end; hinge edentulous, hinge-area somewhat thickened and insinuated under the beak with a single long rib-like tooth extending from the beak to the posterior end. As to internal characters this genus hardly appears to differ from some forms of *Unicardium* in which the cardinal tooth is obsolete, but the shape of the shell is different.

FIMBRIELLA, Stoliczka, 1870.

Type, *F. lævigata*, Sowb. (cxix, 59). Cretaceous; England.

Shell suborbicular, moderately tumid, subequilateral, with prominent, obtuse, incurved beaks, surface partially smooth, partially finely punctate or spinulose; lunular edge in front of the beaks somewhat expanded, hinge in each valve with two conical or subtubercular cardinal teeth: those of the right are superimposed, the upper one being situated on the enlarged lunular margin, those of the left valve are situated beside each other, the anterior much stronger than the posterior, no lateral teeth are present, but the margin is posteriorly internally slightly

grooved; the ligament must have been thin, for there is only a short very narrow space immediately behind the beaks for its attachment, no special nymphæ being present.

Differs from *Unicardium* in the number and position of the hinge-teeth.

CORBICELLA, Morris and Lycett, 1853.

Etym.—Diminutive of *Corbis*.

Distr.—Fossil, 7 sp. Upper part of Inferior Oolite—Oxfordian; England, France. *C. subæquilatera*, Lycett (cxix, 60).

Shell destitute of ornament, ovately elongated, rather compressed; anterior side small; hinge characters differ from those of *Corbis*, in the absence of the anterior lateral tooth, and in the oblique internal ridge passing downwards behind the anterior muscular scar.

Corbicella is intermediate between *Corbis* and *Tancredia*; and from the latter, to which it is more nearly allied, it is separated by its more ovate form, and by the absence of the posterior oblique angle, and in the possession of a lengthened hinge-lamina and depressed remote posterior lateral tooth.

Morris and Lycett state the anterior lateral tooth is always wanting, but though not well developed, it is certainly indicated by the internally strongly thickened margin in such species as *Corb. depressa*, Desh., and still more in *Corb. Barrensis*, Buv.

SPORTELLA, Deshayes, 1852.

Distr.—Fossil, 17 sp. Tertiary; Paris Basin. *S. Cailleti*, Desh. (cxix, 61).

Shell oblong, smooth, depressed, subequilateral; valves closed. Hinge narrow, with two unequal, diverging teeth in the left valve, one in the other; the lateral teeth are wanting. Muscular scars large, oval, nearly equal; pallial line simple. Ligament external.

Possibly some of the Liassic species referred to *Unicardium* belong to this genus.

SPHÆRELLA, Conrad, 1838.

Distr.—3 recent sp. California, Guayaquil, N. Zealand. Cretaceous, Tertiary; United States, Europe. *C. concentrica*, Conr. (cxix, 63).

Shell rounded, tumid, thin; hinge with two cardinal teeth in each valve, the posterior one in the right valve broad, bifid, parallel to the hinge-margin, in the left single, but equally elongated. Some of the palæozoic *Lucinæ* may belong to this genus. Conrad and others class it near *Diplodonta*, but the prolonged posterior teeth appear to indicate a greater relation for the various *Corbinæ*.

TANCREIDIA, Lycett, 1850.

Etym.—Dedicated to Sir Thomas Tancred, Bart., founder of the Cotteswold Naturalists' Club.

Syn.—Hettangia, Terquem. Palæomya, Zitt. and Goub., 1861

Distr.—Fossil, 12 sp. Lias — Bath Oolite; Britain, France.

T. Dionvillensis, cxix, 65. *T. curtansata*, M. and L. (cxix, 66).

T. (Palæomya) Deshayesii (cxix, 64).

Shell trigonal, smooth; anterior side usually longest; cardinal teeth 2·2, one of them small; a posterior lateral tooth in each valve; ligament external; muscular impressions oval; pallial line simple.

This genus is closely related to Meekia of Gabb, Cretaceous, California, but differs in being closed instead of gaping anteriorly, as well as in wanting the peculiar anterior angularity of that type; which also presents some differences in the nature of its hinge-plate, and is said to have its ligament subexternal instead of decidedly external.

MEEKIA, Gabb, 1864.

Distr.—3 sp. *M. radiata*, Gabb (cxix, 67). Cretaceous; California.

Shell oblong, subinequilateral, posteriorly rounded, anteriorly somewhat produced and turned upwards hook-like, terminating in a point; surface marked with striæ of growth only; hinge with two robust, triangular teeth on the right valve, and one large and one small one on the opposite side, the large one being received between the two of the right valve; posteriorly on each side is an indistinct lateral tooth. A short robust plate separates the anterior muscular scar from the cavity of the beak.

FAMILY UNGULINIDÆ.

Shell suborbicular, closed, sometimes a little irregular; hinge composed of two bifid, divergent cardinal teeth, and no laterals; ligament marginal, mantle-margins united, with pedal and anal openings; foot vermiform.

UNGULINA, Daudin.

Etym.—*Ungulina*, like a hoof.

Syn.—Clotho, Basterot, non Faujas.

Distr.—4 sp. Senegal, Philippines, excavating winding galleries in coral. ? Carboniferous, Miocene. *U. oblonga*, Daud. (cxix, 68).

Shell suborbicular; ligament very short; epidermis thick, wrinkled, sometimes black; hinge-teeth 2·2; muscular impressions long, rugose.

Animal with the mantle open below, fringed; siphonal orifice single; foot vermiform, thickened at the end and perforated,

projecting from the base of the shell or folded up between the gills; palpi pointed; gills two on each side, unequal, the external narrower, with a free dorsal border, inner widest in front.

AXINOPSIS, Sars, 1878.

Distr.—*A. orbiculata*, Sars (cxix, 69, 70). Norway.

Shell discoidal, tumid in the middle, compressed towards the margins; umbones slightly prominent; no external ligament; valves thin, pellucid, white, concentrically striate; cardinal tooth in the right valve obtusely elevated, recurved, in the left valve elongated, subhorizontal; cartilage narrow.

MYSIA, Leach, 1819 (Brown, 1827).

Syn.—Diplodonta, Brown, 1831.

Distr.—40 sp. West Indies, Rio, Britain, Mediterranean, Red Sea, West Africa, India, Corea, Australia, California. Fossil, 30 sp. Cretaceous, Eocene—; United States, Europe. *M. Brasiliensis*, Phil. (cxix, 71).

Shell suborbicular, smooth; ligament double, rather long, submarginal; hinge-teeth 2:2, of which the anterior in the left valve, and posterior in the right are bifid; muscular impressions polished, anterior elongated.

Animal with the mantle-margins nearly plain, united; pedal opening large, ventral; foot pointed, hollow; palpi large, free; gills two on each side, distinct, the outer oval, inner broadest in front, united behind; branchial orifice small, simple; anal larger, with a plain valve.

TENEA, Conrad, 1870. Shell roundly ovate, thin, tumid; left valve under the apex with a V-shaped tooth, the anterior lobe of which is continued along the anterior margin of the shell, separated by a deep groove from it; in the right valve are two cardinal teeth united above, the anterior is falcate, with a pit on each side, the posterior curved and directed obliquely backwards. *M. parilis*, Con. (cxix, 72).

FELANIA, Recluz, 1851. Shell sublenticular, equivalve, equilateral, thin, with an epidermis; beaks and lunule small; two divergent subapical teeth, the posterior of the right and anterior of the left valve channeled or bifid; no lateral teeth, but in place of them a deep, long groove on each side the cardinals; ligament cartilaginous, very long; muscular impressions oval-oblong; pallial line with a short trigonal sinus. 10 sp. *M. rosea*, Recluz (cxix, 73, 74).

HIPPAGUS, Lea, 1833.

Distr.—*H. Isocardioides*, Lea. Eocene; Ala.

Shell ovate, higher than long, tumid, with prominent, attenuated incurved beaks; of moderate thickness; internal and external superficial layers of a silky appearance; hinge edentu-

lous, with a simple insinuation or a slight notch; ligamental furrow subinternal; lunule not excavated; muscular impressions ovate, marginal.

PSATHURA, Deshayes, 1860.

Etym.—*ψαθυρᾶς*, friable.

Type, *Erycina fragilis*, Lamk. (cxx, 76, 78). Eocene; Paris Basin.

Shell oval, inequilateral, thin, transparent, fragile; hinge-teeth, in the right valve, two equal and deeply bifid; left valve, two unequal, entire; ligament external; anterior adductor scar narrow, claviform; posterior subquadrangular; pallial line simple, thus differing from *Clementia*, to which it is related by the hinge-characters.

SCACCHIA, Philippi, 1844.

Distr.—2 sp. Mediterranean. Fossil, 1 sp. Pliocene; Sicily. *S. elliptica*, Phil. (cxix, 75).

Shell minute, ovate, posterior side shortest; hinge-teeth 1 or 2, laterals obsolete; ligament minute; cartilage internal, in an oblong pit.

Animal with mantle widely open; siphonal orifice single; foot compressed, linguiform; palpi moderate, oblong.

FAMILY ERYCINIDÆ.

Shells very small, thin, fragile, usually transparent, and sometimes gaping, rounded or transverse, laterally depressed; hinge narrow, with one or two cardinal teeth, the laterals more or less elongated, compressed, sometimes wanting; muscular impressions small, not well-marked; pallial line simple.

ERYCINA, Lam., 1804.

Distr.—12 sp. Fossil, 50 sp. Cret.—Eocene—; N. Am., Paris Basin. *E. Geoffroyi*, Payr. (cxx, 25–27).

Shell equivalve, subinequilateral, usually transversely oval; one, or two unequal, diverging cardinal teeth, separated by a pit; lateral teeth oblong, compressed, short; ligament external and internal; muscular impressions rounded, pallial line simple.

ERYCINELLA, Conrad, 1845.

Distr.—*E. ovalis*, Conr. Miocene; Virginia (cxx, 62); and Crag; England (cxx, 79, 80).

Shell subtrigonal, inequilateral, thick; two cardinal teeth, separated by a pit in each valve; lateral teeth rudimentary; ligament internal; pallial line simple.

SPANIODON, Reuss, 1867.

Type, *S. nitidus*, Reuss (cxx, 83, 84). Miocene; Galicia.

Shell roundly subtrigonal, with somewhat produced obtuse beaks, nearly equilateral; surface only concentrically striated; hinge with an anterior (sublunular) elongated cardinal tooth in each valve, in the right separated from the margin by a deep groove; cartilage in a pit situated below and a little posterior to the beaks; muscular impressions rather large, equal.

MONTACUTA, Turton.

Etym.—Dedicated to Colonel George Montagu, the most distinguished of the earlier English malacologists.

Syn.—Montaguia, Forbes.

Distr.—12 sp. United States, Norway, Britain, Mazatlan. Ægean. *M. substriata*, Forbes (cxx, 85). Fossil, 2 sp. Pliocene—; Britain.

Shell minute, thin, oblong, anterior side longest; hinge-line notched; ligament internal, between two laminar, diverging teeth (with a minute ossicle. Lovén).

Animal with the mantle open in front; margins simple; siphonal orifice single; foot large and broad, grooved.

The Montacutæ moor themselves by a byssus, or walk freely; *M. substriata* has only been found attached to the spines of the purple heart urchin (*Spatangus purpureus*) in 5–90 fathoms. *M. bidentata* burrows in the valves of dead oyster-shells.

The byssal threads by which this curious mollusk attaches itself are exceedingly coarse and strong. Mr. Clark observed it in active motion after he had separated it, still adhering to the spines, from a *Spatangus*. He says: "When the animal marches, its foot is extended, and its rounded termination is instantly fixed to the vase in which it is deposited; then by the retractor muscle it is drawn forward, making such rapid progression as to cross a watch-glass in a minute, and on the passage turns itself several times by a twist of the foot from side to side.

"The gills and green liver are visible through the shell in some specimens which are more transparent than others, the former crossing it diagonally. The shape and position of the cartilage is very remarkable. Sometimes the shell is partly incrustated with a ferruginous deposit. The number of fry, with their shells completely formed, which are found in some individuals, is astonishing. Many hundreds of them, packed close together, and glittering like microscopic pearls, might be counted. They occupy at least two-thirds of the space enclosed within the valves of their parent; and its own body seems to be atrophied and dwindled to a mere skeleton. The shell is in fact turned into a crowded nursery. Perhaps the parent dies, like some insects, immediately after all its progeny have been developed. I do not concur in the general belief that *M. substriata* is para-

sitic. In one sense only can it be said to live on echinoderms. The food of *Spatangus purpureus*, on which it is usually found, appears to consist of animalculæ; and for that purpose it swallows large quantities of shell-sand, causing thereby a strong and frequent current in the neighborhood of its mouth. The *Montacuta* probably avails itself of this in-draught, and partakes of the sustenance intended for the *Spatangus*, placing itself in the way, with its alimentary tube or opening turned in the right direction. No exudation of the *Spatangus* has been noticed; and its excretions would scarcely be produced in sufficient quantity for the support of the *Montacuta*, or perhaps be suitable to it. The latter has no suctorial organ, such as is possessed by all animal parasites; it never attaches itself to the pedicellariæ or any other soft part of the echinoderm; nor has it once been detected on the back or sides, or elsewhere than in the ventral region of its associate. It is only found on the spines close to their points."—JEFFREYS.

TELLINYA, Brown, 1827. Shell transversely oval, surface a little rugose; beaks prominent, acute; hinge with a pit for the ligament, which contains a small ossicle, and a triangular cardinal tooth on each side of it in the right valve, and two distant rudimentary lateral teeth in the left valve. *T. bidentata*, Mont. (cxx, 86). Europe. 6 sp. Eur., Cal., Japan.

KELLIELLA, M. Sars.

Distr.—*K. miliaris*, Phil. (cxx, 87–89). Europe.

Shell minute, orbicular, tumid; umbones slightly prominent, incurved; lunule cordate, distinct; ligament minute; surface white, without epidermis, concentrically striate; cardinal teeth two, laterals none.

LASÆA, Brown, 1827.

Syn.—*Poronia*, Recluz, 1843. *Cycladina*, Cantr. (pars). *Kellia* (pars). *Bornia* (pars).

Distr.—9 sp. Universal. Fossil; Tertiary. *L. rubra*, Mont. (cxx, 90).

Animal with the mantle folded on the anterior side so as to form a wide but incomplete incurrent tube; the excurrent tube is inconspicuous, placed on the opposite side; foot long.

Shell minute and roundish oval; beaks straight; cartilage long, placed at the shorter end of the shell, contrary to that in *Kellia*; left valve with a minute thorn-like cardinal tooth; and in each valve two remarkably strong lateral teeth.

The genus is intermediate between *Montacuta* and *Kellia*.

"The *Lasæa* usually inhabit the littoral zone, where they congregate in vast numbers at the roots of small sea-weeds, in the crevices of rocks, and in empty shells. *L. rubra*, a British spe-

cies, is viviparous, and lives as much out of the sea as in it. Other species occur in various parts of the world."—JEFFREYS.

LEPTON, Turton.

Etym.—*Lepton*, a minute piece of money (from *leptos*, thin).

Syn.—? *Solecardia (eburnea)*, Conrad, 1849.

Distr.—20 sp. Universal. Laminarian and coralline zones. Fossil, 5 sp. Eocene—; United States, Europe. *L. squamosum*, Mont. (cxx, 61).

Shell suborbicular, compressed, smooth, or shagreened, a little opened at the ends and longest behind; hinge-teeth 0·1 or 1·1 in front of an angular cartilage-notch; lateral teeth 2·2 and 1·1.

Animal with the mantle open in front, extending beyond the shell, and bearing a fringe of filaments, of which one in front is very large; siphon single, gills two on each side, separate; foot thick, tapering, heeled and grooved, forming a sole or creeping disk.—ALDER.

PRISTOPHORA, Carpenter, 1866.

Distr.—*P. oblonga*, Carp. San Diego, Cal.

Shell oval, with two diverging teeth in each valve, the anterior being conspicuously shorter than the posterior, sulcated near the beaks, ligament situated in a groove between them.

KELLIA, Turton, 1822.

Etym.—Named after Mr. O'Kelly, of Dublin.

Syn.—*Cycladina (Adansonii)*, Cantr.

Distr.—35 sp. Norway, New Zealand, California. Fossil, 20 species. Eocene—; United States, Europe. *K. suborbicularis*, Mont. (cxx, 92).

Shell small, thin, suborbicular, closed; beaks small; margins smooth; ligament internal, interrupting the margin (in *K. suborbicularis*), or on the thickened margins (in *K. rubra*); cardinal teeth 1 or 2, laterals 1—1 in each valve.

Animal with the mantle prolonged in front into a respiratory canal, either complete (in *K. suborbicularis*) or opening into the pedal slit (in *K. rubra*); foot strap-shaped, grooved; gills large, two on each side, united posteriorly, the external pair narrower and prolonged dorsally; palpi triangular; posterior siphonal orifice single, exhalant.

The hinges of these little shells are subject to variations, which are not constantly associated with the modifications of the mantle-openings. They creep about freely, and fix themselves by a byssus at pleasure. *K. rubra* is found in crevices of rocks at high-water mark, and often in situations only reached by the spray, except at spring-tides; other species range as deep as 200 fathoms. *K. Laperousii* (Chironia), Desh., was obtained, burrowing in sandstone, from deep water, at Monterey, California.

BORNIA, Philippi, 1836. Shell elongately oval, with slightly projecting beaks, almost equilateral, surface finely concentrically striated; hinge with three teeth in the left valve, two small anterior and one somewhat remote and elongated posterior, right valve with only two diverging elongated cardinal teeth; cartilage situated in a groove in front of the posterior teeth; muscular impressions faintly marked. *K. corbuloides*, Phil., occurs recent in the Mediterranean and the Atlantic, and fossil in miocene beds of Italy and the Vienna Basin. *K. seminula*, Phil. (cxx, 93-95).

CYCLADELLA, Carp., 1865. Shell resembling *Ædalina* in form, thin, umbones flattened; ligament external, very thin; the cardinal teeth lie in the curve of the hinge-line, together with the laterals, which are distant.

PYTHINA, Hinds. (Myllita, d'Orb. and Recl.) Shell trigonal, divaricately sculptured; ligament internal; right valve with two lateral teeth, left with one cardinal and two laterals. 13 sp. New Ireland, Australia, Philippines. Fossil, 2 sp. Eocene; France, Java. *P. Deshayesiana*, Hinds (cxx, 96).

CYAMIUM, Philippi, 1845.

Distr.—3 sp. Patagonia, Northern Europe, U. S. Fossil, 1 sp. Tertiary; Europe. *C. Antarcticum*, Phil. (cxx, 97).

Shell oblong; hinge-teeth, 2·2; ligament double; cartilage in a triangular groove behind the teeth in each valve

TURTONIA, Hanley. Shell oblong, inequilateral, anterior side very short; ligament concealed between the valves; hinge-teeth 2·2. Animal with the mantle open in front; foot large, heeled; siphon single, slender, elongated, protruded from the long end of the shell. Greenland, Norway, Britain; in pools and crevices of rocks between tide-marks, and in the roots of sea-weeds and corallines. Mr. Thompson obtained them from the stomachs of mullets taken on the northeast coast of Ireland. *T. minuta*, Hanley (cxx, 98, 99).

HINDSIELLA, Stol., 1870. (*Hindsia*, Desh., 1860. *Vasconia*, Fischer.) Shell elongately subtriangular, nearly equivalve, with the lower margin insinuated, hinge with one or two (generally one in the right, two in the left) minute cardinal teeth in each valve; ligament external, supported by thin fulcra; muscular impression narrow, elongated, pallial line rather broad, simple. *C. lobata*, Desh. (cxx, 100). Grignon.

THECODONTA, A. Ad., 1864.

Distr.—*Th. Sieboldi*, A. Ad. China Seas.

Shell oblong, very inequilateral, the anterior part being shorter than the posterior, concentrically sulcated; hinge in the left valve with two diverging cardinal teeth with a cup-like projecting fold between them, a single posterior lateral tooth present;

pallial line single and radiately grooved, anterior muscular scar triangular, posterior oval.

GALEOMMA, Turton

Etym.—*Galee*, weasel; *omma*, eye.

Syn.—*Hiatella*, Costa (not Daud.). *Parthenopea*, Scacchi (not Fabr.).

Distr.—14 sp. Britain, Mediterranean, Mauritius, Pacific. Fossil, 1 sp. Pliocene—; Sicily. *G. Turtoni*, Forbes and Hanley (cxx, 1).

Shell thin, oval, equilateral, gaping widely below; invested with a thick, fibrous epidermis; beaks minute; ligament internal; teeth 0·1.

Animal with the mantle-lobes united behind and pierced with one siphonal orifice, margins double, the inner with a row of eye-like tubercles; gills large, subequal, united behind; palpi lanceolate, plaited; foot long, compressed, with a narrow flat sole.

The *Galeomma* spins a byssus, but breaks from its mooring at will and creeps about like a snail, spreading out its valves nearly flat.—CLARKE.

THYREOPSIS, H. Ads., 1868. Shell resembling *Galeomma*, nearly equilateral, subtriangular, beaks slightly tumescent, and with the whole of the ventral margins widely gaping. *G. coralliophaga*, H. Ad. (cxx, 2, 3). Mauritius.

SCINTILLA, Desh.

Distr.—53 sp. Philippines, North Australia. Fossil; Eocene. *C. Philippinensis*, Desh. (cxx, 4).

Shell transversely oval, obtusely rounded at the sides, equilateral, thin, shining, sometimes a little gaping; ligament internal, oblique; two diverging cardinal teeth in the left valve, one in the right valve; lateral teeth posterior, one in the right, two in the left valve; pallial impression simple.

PASSYA, Deshayes, 1852. *8/*

Distr.—*P. Eugeniei*, Desh. (cxx, 5). Eocene; Paris Basin.

Shell regular, modioliform, triangular, depressed, greatly gaping on both sides; beaks anterior; hinge short and narrow, with a single tuberculiform tooth; ligament internal? muscular impressions small, submarginal; pallial line simple.

LIBRATULA, Pease, 1865.

Distr.—*L. plana*, Pse. On coral, Pacific Isles.

Semilunar, much compressed (like a *Placuna*), slightly gaping all round, cardinal margin crenulated, cartilage median, internal.

(Solemyacea.)

FAMILY SOLEMYIDÆ.

Shell elongated, transverse, equivalve, regular, very inequilateral, gaping, thin, covered (in Solemya, the recent genus) with a thick epidermis, extending beyond the shell-margins as a fringe; hinge toothless; ligament inserted in an oblique process and hidden; pallial line simple. Along with Solemya have been associated a number of fossil forms agreeing generally in the shape of the shell, yet by no means of certain relationship with it.

SOLEMYA, Lamarck, 1818.

Syn.—Solenomya, Menke, 1828. Janeira, King.

Distr.—6 sp. United States, Canaries, West Africa (Gaboon River), Mediterranean, Australia, New Zealand; burrowing in mud; 2 fathoms. Fossil, 4 sp. Carb.—; Britain, Belgium. 2 Cret. sp.; N. America. *S. Australis*, Lam. (cxxxiii, 63).

Shell elongated, cylindrical, gaping at each end; epidermis dark, horny, extending beyond the margins; umbones posterior; hinge edentulous; ligament concealed; pallial line obscure. Outer layer of long prismatic cells, nearly parallel with the surface, and mingled with dark cells, as in Pinna; inner layer also cellular.

Animal with the mantle-lobes united behind, with a single siphonal orifice, hour-glass shape, and cirrated; foot probosciform, truncated and fringed at the end; gills forming a single plume on each side, with the laminae free to the base; palpi long and narrow, nearly free.

CLINOPISTHA, Meek and Worthen, 1870.

Distr.—*C. antiqua*, Meek (cxx, 16, 17). Devon.; Ohio. *C. radiata*, Hall. Carb.; Ills.

Shell transversely oval, very thin, rather ventricose, equivalve, very inequilateral; beaks near the posterior extremity and directed backward, that of the right valve with its immediate apex curving under the beak of the left, which seems to be a little excavated for the reception of the same; ligament external, short, rather prominent, and occupying an oval or lance-oval shallow cavity, formed by the slight inflection of the margins of the valves immediately behind the beaks; valves with their margins smooth within and closed all around; hinge apparently edentulous; surface smooth, with growth-lines and sometimes traces of fine radiating lines; muscular impressions shallow; pallial line slightly marked, without sinus.

Differs from Solemya in its short gibbous form, want of internal ridge, closed margins, entirely external ligament, ventricose beaks, and their posterior position.

(Carditacea.)

FAMILY CRASSATELLIDÆ.

Shell oblong, posteriorly usually somewhat produced, mostly concentrically striated or sulcated, covered with an epidermis; hinge with a few cardinal teeth, and a cartilage-pit in both valves; lateral teeth, when present, slightly developed, elongated; pallial line entire.

CRASSATELLA, Lamarek, 1799.

Etym.—*Crassus*, thick.*Syn.*—*Pachythærus* and *Scambula*, Conrad.

Distr.—34 sp. Australia, New Zealand, Philippines, India, West Africa, Canaries, Brazil. Fossil, 64 sp. Cret.—; Patagonia, United States, Europe. *C. Antillarum*, Reeve (cxxxiii, 64).

Shell solid, ventricose, attenuated behind, smooth or concentrically furrowed; lunule distinct; ligament internal; margin smooth or denticulated; pallial line simple; hinge-teeth 1-2, striated, in front of cartilage-pit; lateral teeth 0—1, 1—0; adductor impressions deep, rounded; pedal small, distinct.

Animal with mantle-lobes united only by the branchial septum; inhalant margins ciliated; foot moderate, compressed, triangular, grooved; gills smooth, unequal, outer semilunar, inner widest in front; palpi triangular.

In *Crassatella pulchra* the animal is like *Astarte*; foot linguiform, slightly grooved; palpi short and broad, few-plaited; outer gill narrower in front.

CRASSITINA, Weinkauff, 1881. Proposed for the smaller species, with crenated margins of the valves.

PTYCHOMYA, Agassiz, 1842.

Syn.—*Radioconcha*, Conrad, 1869. *Pleuroconcha*, Conrad, 1872.

Distr.—Oolitic, Cretaceous; Europe, U. S. *T. plana*, Agass.

Shell ovately elongated, moderately compressed, beaks close together, placed subanteriorly, surface radiately ribbed, anteriorly generally divaricately striated; hinge with three diverging cardinal teeth in each valve, and the cartilage-pit situated in front of them; muscular impressions elongately oval, rather large; pallial line truncate posteriorly.

ANTHONIA, Gabb, 1864.

Distr.—*A. cultriformis*, Gabb (cxxi, 61, 62). Cretaceous; California.

Shell narrow, compressed, posteriorly very elongated, anteriorly shortly rounded, beaks obtusely pointed; hinge with two elongated, somewhat diverging cardinal teeth in each valve; a

pit is seen posterior to them in both valves, and judging from the general resemblance of the shell to *Crassatella*, it is probably destined to receive a cartilage.

PRONOË, Agassiz, 1843.

Syn.—Venulites, Schloth.

Distr.—Liassic; Europe. *P. triangularis*, Schloth.

Shell subtrigonal, like an *Astarte* or *Cytherea*, with slight concentric striation on the surface; hinge of the right valve with two cardinal teeth, the anterior one extending somewhat below and forming the margin of an elongated pit, above which there is a small sublunular tooth; a small oblique cartilage-pit is situated just behind the beak and a large remote posterior lateral tooth is also present; fulcrum strongly thickened. The hinge of the left valve must possess two cardinal and one sublunular and one posterior double lateral teeth. If Quenstedt's figure and description of the hinge of *P. triangularis*, Schloth., is correct, this would be the oldest form of Crassatellidæ, though, as that author remarks, the hinge-teeth of the right valve very much resemble those of a *Cyprina*; and should it be proved that the small pit is only an accidental depression in which a part of the external ligament is situated, the generic name would have to be cancelled, and the species referred to *Cyprina*, with which the shell perfectly agrees in form.

CRASSATELLINA, Meek, 1871.

Syn.—Etea, Conrad, 1873.

Distr.—*C. oblonga*, Meek (cxxi, 7-9). Cret.; U. S.

Shell transversely trapezoidal, equivale, inequilateral, with free margins closed and smooth within; hinge with two cardinal teeth, and one elongated anterior and one posterior lateral tooth in each valve; anterior cardinal tooth of the left valve trigonal, and deeply emarginate below; posterior very much compressed, oblique, and somewhat elongated; cardinal teeth of right valve diverging, with a triangular pit between for the reception of the larger triangular tooth of the other valve; anterior one small, oblique, and connected at its upper end with the posterior extremity of the anterior lateral; posterior larger, oblique, longitudinally furrowed, and perhaps emarginated below, while just behind and above it there is a narrow oblique slit or pit, for the reception of the thin anterior cardinal of the other valve; lateral teeth elongated parallel to the cardinal margins; the anterior one of the right valve, and the posterior of the left, apparently continued so as to connect with the upper ends of the cardinal teeth; ligament external; pallial line simple.

ERIPHYLE, Gabb, 1864.

Syn.—Dozyia, Bosquet, 1868. *Gouldia*, C. B. Ad. (in part).

Distr.—Recent and Cretaceous; N. Am., Eur. *E. umbonata*, Gabb (cxxi, 11–13).

Shell suborbicular, moderately compressed, with pointed, approximate beaks, with a deep narrow lunule, in external character resembling *Dosinia*; muscular impressions large, but not deeply impressed, pallial sinus moderate, roundish, slightly ascending; hinge strong, in the right valve with two cardinal teeth, the central one strong and thick, often grooved, the anterior thinner and marginal; in the left valve also with two cardinal teeth, the subanterior thick, the posterior thinner; one small anterior lateral (lunule) tooth of the left valve fits into a corresponding pit of the right, and another small longish posterior and remote one of this valve into a corresponding cavity of the left valve. The best known species is *Lucina lenticularis*, Goldf., from the cretaceous beds near Aachen.

This is a very different shell from *Dosinia* as regards hinge-teeth as well as the form of the pallial sinus. It appears very probable that some of the Jurassic *Astartes* (*A. excavatum* and others), belong to this genus, but a very careful examination of the hinge and of the pallial line, which is broad, though very faint, and also of its sinus, will be necessary. The hinge-teeth of *Eriphyla* closely approach those of *Astarte*, but these have no distinct lateral teeth, nor a deep lunule or sinus. It is now generally recognized as a *Crassatellid* genus.

FAMILY ASTARTIDÆ.

Shell thick, solid, equivalve, the cardinal teeth always well-developed, 2–3 in each valve; lateral teeth sometimes present on one or both sides, ligament always external, strong; muscular scars ovate, the anterior usually with a small deep superimposed pit, produced by the retractile muscle of the foot; pallial line entire.

SUBFAMILY ASTARTINÆ.

Shell subtrigonal or roundly oval, with a smooth, concentrically striated or sulcated surface.

ASTARTE, Sowerby, 1816.

Etym.—*Astarte*, the Syrian Venus.

Syn.—*Crassina*, Lamarck, 1818. *Tridonta*, Schum., 1817. *Goodallia*, Turton, 1822 (part).

Distr.—20 sp. Behring's Straits, Wellington Channel, Kara Sea, Ochotsk, United States, Norway, Britain, Canaries, Ægean; 30–112 fathoms. Fossil, 285 sp. Carb.—; North and South America, Europe, Thibet. *A. semisulcata*, Leach (cxxii, 34). *A. Danmoniensis* (cxxiii, 123).

Shell suborbicular, compressed, thick, smooth or concentrically furrowed; lunule impressed; ligament external; epidermis dark; hinge-teeth 2·2, the anterior tooth of the right valve large and thick; anterior pedal scar distinct; pallial line simple.

Animal with mantle open; margins plain or slightly fringed; siphonal orifices simple; foot moderate, tongue-shaped; lips large, palpi lanceolate; gills nearly equal, united behind, and attached to the siphonal band.

The animal of *Astarte borealis* has mantle-margins free, plain, slightly ciliated in the branchial region; united posteriorly by the branchial septum, forming a single excurrent orifice; pedal muscles distinct from adductors; gills flat, finely striated, destitute of internal partitions; outer gill narrow, elliptical, with a simple margin; inner gill grooved, conducting to the mouth.

ASTARTELLA, Hall and Whitney, 1858. The anterior tooth of the right valve has a longitudinal pit in the summit. *A. vera*, Hall (cxxii, 14, 15). Coal-measures; Illinois and Indiana. *not woodi, 1874.*

GONILIA, Stol., 1870. Shell orbicular, small, hinge with three distinct cardinal teeth in each valve, surface with angular striæ, no epidermis. *A. bipartita*, Philippi (cxxii, 35). The round, rather Lucinoid form and the angular striation of the surface indicate in this species a distinct section of Astarte, similar to *Cyclas*, a subgenus of *Lucina*.

LIRODISCUS, Con., 1869. Shell subquadrangular, concentrically ribbed, posterior side lobed by an impressed line; hinge with two cardinal teeth in each valve, right valve with a small pyramidal anterior lateral tooth, left with a posterior one distant from the cardinals. *Ast. tellinoides*, Con. Eocene.

RICTOCYMA, Dall, 1871. Shell and hinge like Astarte; sculpture consisting of broken, nodulous waves, irregularly concentric, covered with a thick epidermis; equivalve and nearly equilateral. *A. mirabilis*, Dall (cxxii, 36). Alaska.

CRASSINELLA, Bayle. Shell obliquely lengthened, subquadrangular. *A. obliqua*, Desh. Jurassic.

PLIONEMA, Conrad, 1872. Shell subrotund, sculptured, with close radiating lines or fine ribs; hinge of left valve with two robust diverging teeth; lunule none. *A. Guerangeri*, d'Orb.

GOODALLIA (Turton, 1822), Deshayes, 1860.

Syn.—Parastarte, Conrad, 1862. Callicistronia, Dall, 1883.

Distr.—Recent; Europe, U. S. Fossil, 8 sp. Eocene; Paris. *G. miliaris*, DeFrance (cxxi, 18).

Shell small, trigonal, equivalve, inequilateral; valves closed; cardinal teeth in the right valve two, diverging, separated by a triangular socket; in the left valve, one triangular, sometimes bifid; lateral wanting, or rudimentary; ligament external, very short; pallial line simple.

GOODALLIOPSIS, Raincourt and Munier, 1863.

Distr.—*G. Orbignyi*, Raine. and Mun. (cxxi, 19, 20). Eocene; Fercourt.

Shell oval, flattened, equivalve, inequilateral, smooth, slightly dilated in front, and compressed behind; valves closed; hinge with two cardinal teeth, separated by a triangular socket, in each valve; lateral teeth distinct and elongated, one in each valve. Other characters those of *Goodallia*.

GROTRIANA, Speyer, 1860.

Distr.—Oligocene; Germany. Cretaceous; So. India. *G. semicostata*, Speyer (cxxi, 21, 22).

Shell roundish, moderately compressed; concentrically sulcated or striated, lunula and area very deeply excavated; beaks produced and pointed, hinge with two or more (often three) cardinal teeth in the right and two in the left valve, the middle tooth in the former and the anterior in the latter being the strongest; each valve with a rib-like marginal lateral tooth on either side, accompanied by a groove, muscular impressions oval, moderately excavated, internal margin finely crenated.

This genus greatly resembles in external form an *Astarte*, but is readily distinguished from it by the presence of the peculiarly elongated lateral teeth and the deep lunula and area. The cardinal teeth equally easily distinguish the genus from *Eriphyla*, Gabb (*Crassatellidæ*), in which the pallial line is truncate posteriorly, or more or less distinctly sinuated.

PRÆCONIA, Stoliczka, 1870.

Syn.—*Hippopodium*, d'Orb. (in part).

Distr.—Oolite—. *P. terminalis*, Romer.

Shell oval, elongated, solid, very inequilateral, beaks sub-anterior, approached, incurved, surface concentrically lamellated or striated; muscular impressions strong; hinge with two cardinal teeth in the left and three in the right valve, the anterior in the latter being often obsolete, and the posterior are in both elongated; sometimes there appears to be an indication of a posterior lateral tooth. This genus includes a great number of chiefly lower and middle mesozoic species; there are scarcely any known from cretaceous deposits.

ALVEINUS, Conrad, 1865.

Distr.—Tertiary; Miss. *A. minuta*, Conr. (cxxi, 23).

Shell smooth, anterior, posterior and ventral margins channeled within; hinge of right valve emarginated under the apex, and having one pyramidal tooth anteriorly; hinge of the left valve with a pit under the apex, and two diverging teeth anteriorly.

LUTETIA, Deshayes, 1860.

Distr.—2 sp. Fossil. Paris Basin. *L. Parisiensis*, Desh. (cxxi, 24).

Shell small, orbicular, globose, equivalve; valves closed; border simple and entire; hinge narrow; cardinal teeth three in each valve, two diverging; the third large and obliquely placed between the others; muscular scars small, oval, submarginal, equal; pallial line simple; ligament external.

MICROMERIS, Conrad, 1866.

Syn.—Pteromeris, Conr., 1865.

Distr.—Eocene; Alabama. *M. minutissima*, Lea (cxxi, 25).

Shell trigonal, with produced, somewhat attenuated, rather straight beaks, ventrally rounded, slightly inflated, striated or sulcated on the surface; the hinge appears to have two small cardinal teeth in the left valve and one in the right, and one long posterior lateral tooth in each.

WOODIA, Deshayes, 1860.

Etym.—Dedicated to Searles V. Wood, a distinguished palæontologist of England. *Syn.*—Digitaria, Wood. 1854, *Craig Moll.* 11, 191.

Distr.—1 recent sp. Mediterranean; also fossil in the Tertiary. *W. marginalis*, Desh. (cxxi, 26).

Shell small, rounded, equivalve, equilateral; valves closed, smooth, or ornamented with oblique, curved striæ; hinge thick; right valve with a single, large, median, triangular tooth, depressed or channeled in the middle; left valve with two narrow, unequal, diverging teeth; lateral tooth wanting or rudimentary; ligament internal, small; muscular scars small, equal, oval or ovate; pallial line simple.

ELATHIA, Issel.

Distr.—*E. Arconatii*, Issel (cxxi, 27, 28). Red Sea.

Shell ovately elongated, much compressed, inequilateral, anteriorly much shorter; concentrically striated; umbones very small, curved in; lunule small, deep; hinge with a single, large, elongated cardinal tooth in each valve.

In form it resembles Goodallia, but also exhibits considerable relation to some of the elongated forms of Loripes.

EULOXIA, Conrad, 1864.

Distr.—*E. latisulcata*, Conr. (cxxi, 16, 17). Miocene; U. S.

Shell like Astarte, somewhat produced posteriorly, hinge apparently with three cardinal teeth in the left valve, the two teeth on the sides being much smaller than the median one, and two teeth in the right valve.

OPIS, DeFrance.

Etym.—*Opis*, a name of Artemis.

Distr.—Fossil, 42 sp. Trias—Chalk; Europe. *O. lunulata*, Miller (cxxi, 33).

Shell strong, ventricose, cordiform, obliquely keeled; beaks prominent, incurved, or subspiral; cardinal teeth 1·1; lunule distinct.

OPISOMA, Stoliczka, 1870. Shell trigonal, much higher than long, with long attenuated slightly incurved and approached beaks, lunule large and deep; hinge with three elongated cardinal teeth in each valve, and a small posterior lateral tooth situated above the posterior muscular impression, which is only slightly larger than the anterior one, both being deeply excavated.

Species referable to this group occur in Upper Jurassic and Cretaceous rocks; in form they perfectly resemble some species of *Opis*, but the hinge is considerably different, possessing more cardinal teeth than are to be observed in that genus. *O. Geinitziana*, Stol. (cxxii, 38).

PROSOCÆLUS, Keferstein, 1857.

Distr.—3 sp. Devonian; Eur. *P. ovalis*, Keferstein (cxxii, 45, 46).

Shell long oval, thick, smooth, lunule deep; cardinal teeth 2·2, the anterior oblique, the posterior strong and lengthened, nearly parallel with the hinge-margin; no lateral teeth; anterior muscular impression deep, posterior shallow.

PACHYDOMUS, Morris, 1845.

Etym.—*Pachus*, thick; *domos*, house.

Syn.—Megadesmus, Sowb.

Distr.—Fossil, 5 sp. Devonian? New South Wales, Tasmania.

Shell oval, ventricose, very thick; ligament large, external; lunette more or less distinct; hinge-line sunk; teeth one or two(?) in each valve; adductor impressions deep; anterior pedal scar distinct; pallial line broad and simple, or with a very shallow sinus.

NOTOMYA, M'Coy, 1847. (*Mæonia*, *Myonia*, *Pyramia*, *Cleobis*, *Dana*.) Shell transversely oval, subequivalve, inequilateral, solid, slightly gaping at both ends; hinge with one strong tooth in the right valve, which appears to correspond to a pit in the left, the two muscular impressions are large and deep, a third, small accessory one is situated above the anterior large one; pallial sinus very small, or only indicated by a truncation of the pallial line; ligament strong, external. Palæozoic; New South Wales. *P. securiformis*, M'Coy (cxxi, 10).

ASTARTILA, Dana, 1849. Shell elongately subtriangular, inequilateral, slightly inflated, moderately thick at the beaks and near

the margins, thin in the middle, on the surface concentrically striated or lamellated; ligament external, very long; muscular impressions rather large, the anterior close to the hinge and with a small superimposed impression; pallial line entire, hinge unknown. *A. intrepida*, Dana (cxxii, 14). Carb.; N. S. Wales. This group is based upon a number of carboniferous species from New South Wales; they greatly resemble in external form the subgenus *Caryatis* of *Cytherea*, but the long ligament and muscular impressions appear to be very similar to those of *Astarte*. The examination of the hinge-teeth is required for the correct determination of the family to which these shells belong.

MECYNODON, Keferstein, 1857.

Distr.—Devon.; Eur. *M. carinatus*, Goldfuss (cxxii, 42, 43).

Shell rather long, thin, concentrically striated or smooth, with a diagonal keel, extending from the beak to the posterior margin; ligament external, short; hinge in either valve with an elevated, long tooth parallel with the hinge-margin, and a pit, posterior to the tooth in the right valve, and anterior to it in the left, in both valves a long and stout posterior lateral tooth; anterior muscular impression deep, with a smaller but deeper impression of the foot-retractor behind it; posterior impression near the middle of the posterior margin.

SUBFAMILY CARDITINÆ.

Shells roundly ovate or transversely elongated, always provided with radiating ribs or striae.

CARDITA, Bruguière, 1789.

Etym.—*Cardia*, the heart.

Syn.—*Arcinella*, Oken. *Pseudocardia*, *Vetocardia*, Conrad. *Actinobolus*, Klein, 1753.

Distr.—50 sp. Universal. Fossil, 5 sp. Lower Silurian—Trias; United States, Europe, New South Wales, Tasmania. *C. sulcata*, Lam. (cxxiii, 67). *C. antiquata*, Linn. (cxxiii, 68).

Shell oblong, radiately ribbed; ligament external; margins toothed; hinge-teeth 1·2, and an elongated posterior tooth; pallial line simple; anterior pedal scar close to adductor.

Animal with the mantle-lobes free, except between the siphonal orifices; branchial margin with conspicuous cirri; foot rounded and grooved, spinning a byssus; labial palpi short, triangular, plaited; gills rounded in front, tapering behind, and united together, the outer pair narrowest.

REDONIA, Rouault. Shell oval, tumid; hinge with cardinal and posterior teeth; anterior adductor bounded by a ridge. Fossil. Lower Silurian; Brittany, Portugal. *C. Deshayesiana*, Rouault (cxxii, 47, 48).

MILNERIA, Dall, 1881.

Etym.—In honor of the late Dr. J. W. Milner, of the U. S. Fish Commission. *Syn.*—Ceropsis, Dall, 1871.

Distr.—*M. minima*, Dall. Nestling in Haliotis, California.

Shell small, ribbed or sculptured; with a Δ -shaped cardinal tooth in the right valve; left valve with a stout anterior and slender posterior cardinal tooth, diverging, and a very slight groove in the posterior margin; no lateral teeth in either valve, and no groove in the right valve; umbones almost posterior, general form trapezoidal.

MYTILICARDIA, Blainv., 1824.

Distr.—24 sp. Universal. *M. variegata*, Brug. (cxxxiii, 69).

Shell elongated, very inequilateral, with squamous radiating ribs; hinge with an anterior triangular cardinal tooth; posterior cardinal tooth double in the left valve; no anterior laterals.

Foot rounded, grooved, byssiferous.

AZARELLA, Gray, 1852. (Beguina, Bolten, 1798.) Shell compressed, margins rounded, striated; hinge elongated, submarginal, without lateral teeth. *M. semiorbiculata*, Linn. (cxxxiii, 70, 71).

GLANS, Muhlfeldt, 1811. Shell trapezoidal, with radiating ribs. *M. trapezia*, Brug.

THECALIA, H. and A. Adams, 1855. Shell oblong, radiately ribbed; interiorly with a remarkable cup-like inflection of the ventral margin of each valve, resembling the cup of a Calyptræa. *M. concamerata*, Chemn. (cxxxii, 49).

PALÆOCARDITA, Con., 1867. Shell elongately trapezoid, inequilateral, moderately inflated, radiately ribbed; hinge with two blunt cardinal teeth and one posterior lateral tooth in each valve. Conrad proposed this group for the Triassic *Cardium austriacum*, Hauer, but the better known Cassian *Cardita crenata*, Münst. (cxxxii, 50, 51), may rather be considered as the type. These cretaceous Mytilicardiæ mostly differ from the recent species by the want of an anterior insinuation of the ventral margin, where in true Mytilicardiæ there should be a small gape; the posterior cardinal is also less elongated in the fossil forms.

CARDITAMERA, Conrad, 1838.

Syn.—Lazaria, Gray, 1853.

Distr.—6 sp. W. Coast N. America, W. Indies, Madagascar. Fossil. Miocene; U. S. *C. pectunculus*, Brug. (cxxxiii, 72).

Shell transverse, oblong, inequilateral, beaks subanterior, radiately ribbed; hinge with two cardinal and two lateral diverging teeth in each valve, the posterior teeth being in each case much elongated, the anterior short and more or less pointed, sub-lunular.

VENERICARDIA, Lam., 1801.

Syn.—Cardiocardita, Blainv.

Distr.—*V. planicostata*, Lam. (cxxxiii, 73). Fossil; Cret., Tert.

Shell suborbicular, inequilateral, radiately ribbed; hinge with two oblique cardinal teeth, and no laterals.

Animal locomotive, with a sickle-shaped foot, like *Cardium*.

CYCLOCARDIA, Con., 1867. Rounded, radiately costate, covered with a rough epidermis; hinge with two robust teeth in the left valve, directed obliquely backwards, the posterior one elongated and slightly curved; anterior tooth of the right valve rudimentary. *V. borealis*, Con. (cxxxiii, 74). 3 sp. U. S.

PLEUROMERIS, Conrad, 1867. Shell subtriangular, radiately ribbed, hinge in the right valve with one broad, furrowed, recurved tooth, in the left valve with three teeth, the anterior one small and fitting into a cavity in the opposite valve. *V. tridentata*, Say (cxxxii, 60).

MIDON, Carpenter, 1864.

Distr.—*M. prolongatus*, Carp. West Coast U. S. *M. orbicularis*, Sowb. (cxxxii, 52–54). Oolite; England.

Shell ovately subtrigonal, small, solid, ventrally much produced, with the umbones situated anteriorly, radiately ribbed, the ribs being partially intersected by concentric sulcations; hinge in the right valve with one posterior cardinal and one anterior lateral tooth, left valve with one triangular anterior and one elongated posterior cardinal, and a very small anterior lateral tooth. Closely allied to *Pleuromeris*.

PROROKIA, Boehm, 1883.

Distr.—Fossil, 4 sp. *P. (Cardita) ovalis*, Quenst.

Shell small, long-ovate, equivalve, very inequilateral, beaks slightly curved, anterior; surface concentrically striate; inner margin thickened and crenulated; teeth 1·2, with a slightly developed posterior lateral and a still smaller anterior lateral; anterior impression linear, deep, surrounded by a peculiar swelling, posterior impression on a raised plate.

CARDITELLA, E. A. Smith, 1881.

Distr.—3 sp. S. Am. *C. pallida*, Smith.

Shell exteriorly like *Cardita*; hinge composed of two cardinal teeth in the left valve and one in the other; each valve has also two lateral teeth, one nearly marginal on the one side, the other on the opposite side being well within the outer edge, with a groove between it and the margin for the reception of the sub-marginal tooth of the other valve; external ligament small, yet distinct; internal cartilage minute, placed immediately beneath the apex of the valves; pallial line simple.

CARDITOPSIS, E. A. Smith, 1881.

Distr.—*C. flabellum*, Reeve.

Shell without external ligament; cardinal teeth one on one side of the cartilage-pit, and two united above on the other side; lateral teeth more delicate than in *Carditella*, internal ligament considerably larger.

PLEUROPHORUS, King, 1848.

Syn.—Unionites, Wissm.

Distr.—*P. costatus*, Brown (cxxi, 6). Permian; England.

Shell oblong; dorsal area defined by a line, or keel; umbones anterior, depressed; hinge-teeth 2·2; laterals 1·1, elongated, posterior; anterior adductor impression deep, with a small pedal scar close to it, and bounded posteriorly by a strong rib from the hinge; pallial line simple.

MATHERIA, Billings, 1858.

Etym.—Dedicated to Mr. Mather, of the Geological Survey of New York.

Distr.—*M. tenera*, Billings (cxxii, 57–59). Trenton limestone; Canada.

Shell transverse, equivalve; beaks near the anterior end; two small obtuse cardinal teeth in the left valve, and one in the right; ligament external.

SEPTOCARDIA, Hall and Whitfield.

Distr.—*S. typica*. Jurassic; Nevada. *S. rara*, Meek (cxxii, 55, 56).

Shell inequilateral, cordiform; hinge strong; right valve with a strong, recurving, hooked tooth under the beak, and a deep cavity below and exterior to it, which is profoundly excavated in the thickened substance of the shell; in the left valve a large deep cavity corresponds to the tooth of the right valve; lateral teeth obsolete; ligament external, situated in a groove formed by a thickened, overlapping portion of the shell posterior to the tooth and corresponding cavity; anterior adductor muscular scar very large and deep, separated from the general cavity of the shell by a calcareous plate, or septum, extending across the anterior end of the valve on the inner side of the scar, thereby forming a distinct chamber in each valve; posterior adductor scar much smaller, situated within the posterior cardinal margin; pedal scars not observed; surface of the shell marked in the typical species by strong, elevated, radiating ribs, with ornamented surfaces similar to many of the recent species of *Cardium*.

ANODONTOPSIS, M'Coy, 1851.

Distr.—Silur.; Eng., U. S. Type, *A. angustifrons*, M'Coy.

Shell rather compressed, subtrigonal or trapezoid, anteriorly generally somewhat narrowly rounded, posteriorly obliquely truncate, hinge rectilinear, shorter than the length of the shell, with an internal posterior marginal tooth, double in the right valve, and a second shorter one in front of the beaks; a small cardinal tooth is said to be occasionally present below the beaks; muscular scars ovate, the posterior larger and stronger than the anterior; pallial line entire.

Stoliczka considers *Microdon*, Conrad (p. 191), identical with *Anodontopsis*.

PSEUDAXINUS, Salter. Shell thin, edentulous, convex, with prominent umbones, and a strong posterior carinated edge; beaks anterior; no lunette. *A. securiformis*, M'Coy, and allied forms.

ORTHODONTISCUS, Meek, 1873. Right valve with a well-defined cardinal tooth, left valve with a corresponding fosset and a rudimentary tooth in front of it; lateral teeth double in the right valve, single in the left. *A. Milleri*, Meek. Silur.; Ohio.

PACHYCARDIA, Hauer, 1857.

Distr.—*P. rugosa*, Hauer. Alpine Trias.

Shell long-oval, nearly trigonal, very inequilateral, concentrically striated or smooth; beaks prominent, approaching, nearly terminal; anterior side strongly swollen, with lunule; posterior side somewhat compressed; margins smooth, the ventral convex in outline; ligament external, short; teeth two in each valve, strong, diverging, the anterior in the right valve less developed and nearly marginal; a long, posterior, lateral tooth in each valve; muscular impressions small, the anterior deep.

ORDER ASIPHONIDA.

Mantle-margins open; no siphons; pallial impression without sinus.

Suborder HOMOMYARIA. Mantle-margins open or closed behind; both muscular impressions equally distinct.

Suborder HETEROMYARIA. Frequently inequivalve; anterior muscular impression very small, posterior impression large.

Suborder MONOMYARIA. Having a single posterior or sub-central adductor-muscle and impression.

SUBORDER HOMOMYARIA.

(*Cardiniacea*.)

FAMILY CARDINIIDÆ.

Shell obliquely lengthened or oval, smooth or concentrically striated; ligament external, moderately long; cardinal teeth

usually but slightly prominent, sometimes obsolete; lateral teeth more or less developed, often very thick; muscular impressions simple, deep. (Entirely fossil.)

CARBONICOLA, M'Coy, 1855.

Distr.—20 sp. Carboniferous; Europe, United States. *C. acuta*, Sowb. (cxxxiv, 97).

Shell elongated, solid, with moderately tumescent, not eroded, beaks, somewhat impressed in front of them; ligament strong, external; surface concentrically striated; hinge with one very thick cardinal tooth in the right valve, extending posteriorly, with one long anterior and one long posterior lateral tooth; muscular scars one either side, each surmounted by a small accessory impression.

ANTHRACOSIA, King, 1856.

Etym.—*Anthrax*, carbon, in allusion to the carboniferous deposits in which the genus is usually found.

Distr.—61 sp. Devonian—Carboniferous; Westphalia, Saxony, Russia, Belgium, Great Britain, N. America. *A. Lottneri*, Ludwig (cxxxv, 10).

Shell equivalve, inequilateral. Teeth one in each valve below the umbone, rather low and massive; crown of tooth of right valve excavated anteriorly and ridged posteriorly; crown of tooth of left valve ridged anteriorly and sloped posteriorly. Umbonal ligamental fulcra each a furrow excavated in the hinge-plate, between the umbone and tooth; scars of the anterior set of pedal muscles, situated above the anterior adductor muscular impressions.

Anthracosia differs from *Unio*, to which genus the majority of the Unioniform shells have been referred, in its simpler dental system and in the absence of supplementary pedal muscles.

ANOPLOPHORA, Sandberger, 1862.

Syn.—Unionites, Munst. Myacites, Auct.

Distr.—Triassic. *A. lettica*, Quenst. (cxxxii, 37).

Shell elongated, laterally moderately compressed, inequilateral, beaks subanterior, hinge with a small indentation, without any perceptible cardinal teeth and with very slightly thickened lateral margins on either side; anterior muscular impression cordiform, enlarged, posterior very faint, ligament linear, external.

Most of the species referable to this genus occur in the Trias; they differ from *Cardinia* by the want of hinge-teeth, and some forms closely resemble *Pleurophorus*, but they appear to have a thinner shell.

TRIGONODUS, Sandberger, 1864.

Distr.—*T. Sandbergeri*, Alberti (cxi, 29, 30). Triassic.

Shell like *Cardinia*, hinge also nearly the same, except that the posterior lateral tooth is very strong, single in the right and double in the left valve; anterior lateral tooth short and small; cardinal teeth distinct; muscular impressions elongated and attenuated above. Closely allied to *Cardinia*.

CARDINIA, Agassiz, 1841.

Etym.—*Cardo-inis*, a hinge.

Syn.—*Thalassides*, Berger, 1833 (no description). *Sinemuria*, Christol. *Pachyodon*, Stutch. *Ginorga* and *Dihora*, Gray. *Storhodon*, Brown.

Distr.—Fossil, 71 sp. Silurian—Inferior Oolite; Europe, along with marine shells. *C. Listeri*, Sowb. (cxi, 31).

Shell trigonal or ovately elongated, compressed, inequilateral, with pointed, not very prominent beaks, these being close together; hinge with one cardinal tooth in the right valve and two small ones in the left, and one remote lateral tooth on either side in each valve; muscular impressions deep, rather small, and situated next to the lateral teeth; ligament of moderate strength, but long.

This genus is sparingly (and rather doubtfully) represented in Silurian rocks; its maximum of development falls in the Lias, and it disappears with the close of the Jurassic period.

(*Naiades*.)

FAMILY UNIONIDÆ.

Shell usually regular, equivalve, closed; structure nacreous, with a very thin prismatic-cellular layer beneath the epidermis; epidermis thick and dark; ligament external, large and prominent; margins even; anterior hinge-teeth thick and striated, posterior laminar, sometimes wanting; adductor scars deeply impressed; pedal scars three, distinct, two behind the anterior adductor, one in front of the posterior.

Animal with the mantle-margins united between the siphonal orifices, and, rarely, in front of the branchial opening; anal orifice plain, branchial fringed; foot very large, tongue-shaped, compressed, byssiferous in the fry, and sometimes in the adult; gills elongated, subequal, united posteriorly to each other and to the mantle, but not to the body; palpi moderate, laterally attached, striated inside; lips plain. Sexes distinct.

The river-mussels are found in the ponds and streams of all parts of the world. In the old world the species are comparatively

few, though specimens are abundant; in North America both species and individuals abound.

Like other fresh-water shells, the Naiades are often extensively eroded by the carbonic acid dissolved in the water they inhabit. This condition of the umbones is conspicuous in the great fossil Uniones of the Wealden, but cannot be detected in the Cardiniæ, and some other fossils formerly referred to this family.

The outer gills of the female Unio are filled with spawn in the winter and early spring; the fry spins a delicate, raveled byssus, and flaps its triangular valves with the posterior shell-muscle, which is largely developed, whilst the other is yet inconspicuous. The shells of the female river-mussels are rather shorter and more ventricose than those of the males.

Over 1200 recent species of Unionidæ are known to science and more than half of these are inhabitants of the rivers of the United States. A large proportion of the species was first described by Dr. Isaac Lea of Philadelphia, who has devoted over fifty years to the study of this family. His "Observations on the genus Unio, with descriptions of new species," etc., now comprises thirteen quarto volumes, illustrated by hundreds of beautiful plates.

UNIO, Retz.

Etym.—*Unio*, a pearl (Pliny). River-mussel.

Syn.—*Uniomeris*, Conr. (Eocene).

Distr.—1000 sp., universal. Fossil. Cretaceous, Eocene—; Europe. Triassic—; N. Amer. *U. littoralis*, Linn. (cxxxiii, 86).

Shell oval or elongated, smooth, corrugated, or spiny, becoming very solid with age; anterior teeth 1·2, or 2·2, short, irregular; posterior teeth 1·2, elongated, laminar.

Animal with the mantle-margins only united between the siphonal openings; palpi long, pointed, laterally attached.

The subgenera are mainly founded upon peculiarities of form and ornamentation or sculpture; they are of no value except as conveniences for classifying the species; and Dr. Isaac Lea, the great authority upon this family, has discarded them altogether and used instead, in his admirable "Synopsis of Unionidæ," a division into sections by the form of the shell, and these into subsections by the sculpture.

I annex the so-called subgenera, as adopted by H. and A. Adams, Chenu and others.

BARIOSTA, Rafinesque, 1831. (Potamida, Swainson, 1840.) Shell arcuated, smooth. *U. emarginatus*, Lea (cxxxiii, 75).

NAIDEA, Swainson, 1840. Shell obovate or mytiliform, smooth. *U. Modioliformis*, Lea (cxxxiii, 76).

NAIA, Swainson, 1840. Shell oblong, smooth. *U. depressus*, Lam. (cxxxiii, 77).

HYRIDELLA, Swains., 1840. (*Micromya*, Agassiz, 1852.) Shell oval, smooth. *U. batavus*, Lam. (cxxiii, 78).

OBOVARIA, Rafinesque. Shell subrotund, smooth. *U. retusus*, Lam. (cxxiii, 79, 80).

LAMPSILIS, Rafinesque, 1820. (*Pleurobema*, *Plagiola*, *Scale-naria*, *Syntoxia* and *Truncilla*, Rafinesque. *Æglia*, Swains., 1840.) Shell more or less triangular or oblique, truncated posteriorly, smooth. *U. elegans*, Lea (cxxiii, 81).

CANTHYRIA, Swainson, 1840. Shell subtrigonal, spinose. *U. spinosus*, Lea (cxxiii, 82).

IRIDEA, Swainson, 1840. Shell oval or wide, nodulous. *U. cylindricus*, Say (cxxiii, 83). *U. perplexus*, Lea.

ROTUNDARIA, Rafinesque, 1830. Shell obliquely rounded, nodulous. *U. pustulosus*, Lea.

QUADRULA, Rafinesque, 1820. (*Theliderma*, Swainson, 1840.) Shell subquadrangular, tuberculated. *U. apiculatus*, Say.

DIPLODON, Spix, 1827. Shell oval, oblong or wide, plicate. *U. pliciferus*, Lea. *U. Grayanus*, Lea.

DYSNOMIA, Agassiz, 1851. Shell triangular or quadrangular, plicate. *U. plicatus*, Lesueur (cxxiii, 84).

METAPTERA, Rafinesque, 1820. Shell with a wing-like postero-dorsal prolongation of the valves, by which they become connate or soldered together. *U. alatus*, Say (cxxiii, 85). *U. delphinus*, Gruner.

UNIOCARDIUM, Capellini. Obliquely lengthened, very inequilateral, the margin produced below, with a posterior sharp rib or angle. Fossil. Congarienschichten, Sterza.

UNIONA, Pohlig, 1880. Shell thick, somewhat inequivalve, with a lunule; apex eroded; hinge with two three-cornered teeth in the right valve and one in the left valve, right valve with one short lateral tooth, left with two; near the anterior muscular impression are two accessory impressions. 2 sp. Triassic; Germany. *U. maritima*, Pohlig.

LOXOPLEURUS, Meek, 1876. Elongate-subovate, somewhat arcuate, without wings, ornamented with two sets of very regular, well-defined costæ, those of one of which start from the margin just in front of the beaks, and radiate obliquely backward and downward; while those of the other set start from the dorsal margin behind the beaks, and extend downward in a direction that would cause them to intersect those of the other series at rather acute angles along the posterior umbonal slopes somewhat as in *Goniomya*. *U. belliplicatus*, M. Fossil. Wyoming, near junction of Cret. and Lower Tertiary.

The following arrangement by Dr. Lea is based upon the same characters as the above "subgenera," but is a more comprehensive scheme, providing pretty well for the natural grouping of all the species.

Genus *Margaron*, Lea.
Subgenus *Unio*, Retzius.

Symphynote—

Plicate.

Smooth. Triangular, oval, oblong.

Non-Symphynote—

Plicate. Quadrate, triangular, oval, oblong, subrotund, wide, arcuate.

Nodulous. (Subdivided as above under "Plicate.")

Spinous. Triangular.

Sulcate. Triangular, oval, oblong, subrotund.

Smooth. Triangular, oblique, oval, oblong, subrotund, wide, obovate, arcuate.

MARGARITANA, Schumacher, 1817.

Syn.—*Baphia*, Meuschen, 1787.*Distr.*—40 sp. N. America, Europe. Fossil. Cret.—; N. Am.Shell like *Unio*, but without lateral teeth.

There is so little difference between this genus and *Unio*, that for systematic purposes it would be better placed as a subgenus of the latter: the universal custom of using its generic name in connection with the species prevents such disposition of it. Dr. Lea applies to the classification of this genus the same admirable scheme which he has used for the *Uniones*. H. and A. Adams restrict the typical group to those species having smooth, oblong, transverse shells, and then admit the three following subgenera, which might better be suppressed, and their names added to the generic synonymy. *M. margaritifera*, L. (cxxiv, 88, 89), the species which afforded the once-famous British pearls, is circumboreal in distribution, occurring in Europe, Siberia, British America and the Northern United States. It is a remarkable exception to the rule of limited distribution of the species of the family.

ALASMODONTA, Say, 1820. Shell subtrigonal, inflated, beaks prominent, surface smooth. *M. Curreyana*, Lea.

COMPLANARIA, Swains., 1840. Valves connate, surface plicate. *M. confragosa*, Say.

UNIOPSIS, Swainson, 1840. (*Calceola*, Swainson, 1840.) Shell ovate; surface of valves smooth; cardinal teeth two, irregular or receding from the anterior margin, or with tubercles and undulations representing cardinal teeth. *M. calceola*, Lea.

MONOCONDYLÆA, d'Orb., 1835.

Distr.—30 sp. South America, Southern Asia. *M. Guarayana*, d'Orb. (cxxiv, 90).

Shell externally like *Unio*, internally the hinge, like *Margaritana* possesses cardinal but not lateral teeth; the cardinals are peculiar

in being single in each valve, and tubercular, not entering a pit in the opposite valve, that of the right valve being posterior to the left. The typical group comprises South American species; the following subgenera, proposed for Asiatic species, have very slight distinctive characters.

PSEUDODON, Gould, 1844. The hinge-tooth of the right valve fits into an emargination situated in front of the beak of the left valve, while the tooth itself of this latter valve is below the beak. *M. Peguensis*, Anthony. Burmah.

TRIGONODON, Conrad, 1865. The hinge-tooth of the right valve erect, almost vertically or obliquely elongated, fitting into a divided tooth of the left valve, the posterior portion of the left tooth being much larger than the anterior. *M. crebristriata*, Anthony. Pegu.

LEGUMINAIA, Conrad, 1865. Outline approaching *Margaritana margaritifera*, being medially contracted and of an oblong and leguminous shape. The cardinal tooth is pyramidal and recurved, wholly unlike the transverse compressed tooth of Pseudodon. *M. Mardinensis*, Lea. River Tigris.

Dr. Stoliczka, commenting upon the above groups, concludes thus:

"Large series of all these shells in different stages of growth should be examined, for there is no doubt that they gradually pass one into the other, and connect *Margaritana* with *Unio*. Certainly nothing can be more unnatural than creating new generic groups upon the examination of single shells, particularly among such most variable forms as the fresh-water Unionidæ are known to be, and then attempting to assimilate the various species to the imaginary characteristics. It is just the contrary way, we have to take in a natural classification."

MICROCONDYLÆA, Vest. Gills united to the mantle in their entire length, a small cardinal tubercle in each valve. *Margaritana Bonelli*, Fer. Europe.

PLAGIODON, Lea, 1856.

Distr.—*P. Isocardioides*, Lea (cxxxiv, 91). Rio Plata.

Shell inequivalve, ventricose, obliquely trigonal; cardinal teeth transverse, crenulated, compressed, double in each valve; no lateral teeth.

DIPSAS, Leach, 1814.

Syn.—*Barbala*, Humphrey, 1797. *Dianisotis*, Raf., 1831. *Symphynota*, Swains., 1840.

Distr.—2 sp. China. *D. plicatus*, Leach (cxxxiv, 92).

Shell usually alate or winged postero-dorsally; hinge with a single long linear tooth on the dorsal margin.

ANODONTA, Cuvier.

Etym.—*Anodontos*, edentulous. Swan-mussel.

Syn.—*Limnæoderma*, Poli, 1835. *Hemiodon*, Swains., 1840.

Distr.—200 sp. World-wide. Fossil. Laramie Gr.—; N. Am. *A. cygnea*, Linn. (cxxxiv, 96).

Shell like *Unio* externally, usually much thinner and smooth; hinge without teeth.

Dr. Lea divides the species as he does *Unio*.

The following subgeneric groups are without much value:

LAMPROSCAPHA, Swainson, 1840. Shell transversely elongated, narrow; beaks subanterior. *A. ensiformis*, Spix.

PATULARIA, Swainson, 1840. (*Glabaris*, Gray.) Shell cordiform or rounded. *A. latomarginata*, Lea (cxxxiv, 94).

GONIDEA, Conrad, 1857. Shell wedge-shaped, posterior slope defined by a high angle; a rudimentary cardinal tooth in the right valve fits into a depression in the left valve. *A. angulata*, Lea (cxxxiv, 95).

?AMNIGENIA, Hall, 1883. Like *Anodonta* in form and external characters; probably fresh-water or estuary. *A. Catskillensis*, Vanuxem. Fossil; Oneonta sandstone, N. Y.

FAMILY IRIDINIDÆ.

Shell externally like *Unio*; hinge-line usually crenated, making numerous transverse teeth, or with lamellar teeth more or less crenated.

Mouth and lips small, labial palps very large, oval, attached by their straight edges, without any free points as in *Unionidæ*. Mantle-lobes united posteriorly, and prolonged into two short, unequal siphonal tubes; gills large, nearly equal, united to the body. Foot large, thick, compressed, tongue-shaped, angular in front.

IRIDINA, Lamarck, 1819.

Etym.—*Iris*, the rainbow.

Syn.—*Mutela*, Scop., 1777. *Platiris*, Lea.

Distr.—9 sp. Rivers of Africa, Nile, Senegal. *I. exotica*, Lam. (cxxxiv, 99).

Shell oblong; umbones depressed; hinge-line long, straight, attenuated towards the umbones, crenated by numerous unequal teeth; ligament long and narrow.

Animal with mantle-lobes united posteriorly, forming two short siphons; mouth and lips small; palpi immense, oval; gills united to the body.

CALLISCAPHA, Swains., 1840. Hinge crenated near the umbones only. *I. Nilotica*, Lam.

PLEIODON, Conrad, 1835. Cardinal margin wide, profoundly crenulated. *I. ovata*, Swainson (cxxxiv, 100).

SPATHA, Lea, 1838. Shell oval, thick; cardinal margin arcuated and nearly smooth. Outer gill united to the mantle as far as its extremity; inner gill not united to the foot. *S. rubens*, Lea (cxxiv, 8). E. Africa.

LEILA, Gray, 1842. (Columba, Lea.) Shell oval, inflated, very inequilateral, gaping, with prominent beaks; cardinal margin straight, simple. *L. Blainvilleana*, Lea (cxxiv, 5). So. America.

? HAPLOTHÆRUS, Conrad, 1874. Equivalve; hinge-margin straight, cartilage-area very broad and thick, hinge edentulous; anterior muscular scar small, narrow, and deeply impressed, accessory situated under the primary scar. *H. capax*, Conr. (cxxv, 8, 9). Fossil; Pebas Group, Upper Amazon. Described from fragments; the portion containing the posterior muscular impression is missing.

TRIQUETRA, Klein, 1753.

Syn.—Hyria, Lam., 1819. Pachyodon, Schumacher, 1817. Triplodon, Spix, 1827.

Distr.—4 sp. South America. *T. avicularis*, Lam. (cxxiv, 2). *T. corrugata*, Lam. (cxxiv, 1).

Shell Arca-shaped, hinge-line straight, with a dorsal wing on the posterior side; hinge with cardinal and lateral teeth, the latter serrated. Mantle-lobes united together behind and furnished with two short, contractile siphons.

PRISODON, Schum., 1817.

Syn.—Tetraplodon, Spix, 1827. Castalia, Lamarek, 1819.

Distr.—3 sp. Rivers of South America, Guiana, Brazil. *P. ambigua*, Lam. (cxxiv, 3, 4).

Shell ventricose, trigonal; umbones prominent, furrowed; hinge-teeth striated; anterior 2·1, short; posterior 1·2, elongated.

Animal with mantle-lobes united behind, forming two distinct siphonal orifices, the branchial ciliated; outer gill united to the mantle as far as its extremity; buccal appendages rounded, very large; foot much compressed, thicker and bent behind.

ARCONAIA, Conrad, 1865.

Distr.—*A. (Triquetra) contorta*, Lea (cxxv, 16, 17). China.

Shell elongated, bent or bow-shaped; hinge with two distant, oblique, robust, short cardinal teeth, finely rugose-striate; lateral teeth elongated, minutely rugose-striate (not serrated).

FAMILY MYCETOPODIDÆ.

Shell thin, soleniform, transversely elongated, gaping at both extremities; hinge-line straight, linear, without teeth.

Animal with greatly developed foot, ending in a disk-like expansion.

MYCETOPUS, d'Orbigny, 1835.

Etym.—*Mukes*, a mushroom; *pous*, the foot.

Distr.—3 sp. River Parana, Corrientes; River Amazon, Bolivia. *M. soleniformis*, Orb. (cxxxv, 11).

Shell elongated, subcylindrical, gaping in front; margins subparallel, hinge edentulous.

Animal with an elongated, cylindrical foot, expanded into a disk at the end; mantle open; gills equal; palpi short.

SOLENAIA, Conrad. Elongated, thin, gaping anteriorly, hinge with a long, acicular lateral tooth in each valve, slightly developed. Recent; Oriental. *M. emarginatus*, Lea (cxxxv, 12, 13).

(Ætheriaceæ.)

FAMILY ÆTHERIIDÆ.

Shell irregular, inequivalve, attached, pearly within. Animal without foot. These may be likened to oysters, which they much resemble in the general appearance of the shell. The family includes three somewhat similar genera, one of which is African, the others South American.

ÆTHERIA, Lamarck, 1808.

Etym.—*Aîtherios*, ærial. Fresh-water oyster.

Distr.—4 sp. River Nile, from first cataracts to Fazool; River Senegal. *Æ. Cailliaudi*, Fer. (cxxxiv, 6).

Shell irregular, inequivalve; attached by the umbo and tubular processes of one of the valves, usually the left; epidermis thick, olive; interior pearly, blistered (as if with air-bubbles); hinge edentulous; ligament external, with a conspicuous area and groove in the fixed valve; two adductor impressions, the anterior very long and irregular; pallial line simple.

Animal with the mantle-lobes open; body large, oblong, projecting backwards; no trace of a foot; palpi large, semioval; gills subequal, plaited, united posteriorly, and to the body and mantle.

MULLERIA, Férussac, 1823.

Etym.—Dedicated to Otto Frid. Müller, author of the "Zoologia Danica." *Syn.*—*Acostæa*, d'Orbigny, 1851.

Distr.—River Magdalena, near Bogota, New Grenada. *M. Guaduasiana*, Orb. (cxxxv, 14, 15).

Shell, when young, free, equivalve, Anodon-shaped, with a long and prominent ligament, and two adductor impressions; adult irregular, inequivalve, attached by the right valve; umbones elongated, progressively filled up with shell, and forming an irregular "talon" in front of the fixed valve; epidermis thick; ligament in a marginal groove; interior pearly, muscular impressions single, posterior.

BARTLETTIA, H. Adams, 1866.

Distr.—*B. Stefanensis*, Moric. cxxiv, 7). Amazon River.

Shell free, equivalve, closed, inequilateral, the anterior portion being peculiarly produced and rugose, the ventral edge insinuated, hinge edentulous; ligament marginal, partially internal, supported by strong fulera, muscular scars two, marginal; pallial line entire.

This singular shell has the irregular growth of the attached genera, except that it is equivalve; in possessing two muscular scars it is nearest allied to *Ætheria*.

(*Trigoniacea*.)

FAMILY TRIGONIIDÆ.

Shell equivalve, close, trigonal, with the umbones directed posteriorly; ligament external; interior nacreous; hinge-teeth few, diverging; pallial line simple.

Animal with the mantle open; foot long and bent; gills two on each side, recumbent; palpi simple.

TRIGONIA, Bruguière.

Etym.—*Trigonos*, three-angled.

Syn.—*Lyriodon*, G. Sowerby. *Myophorella*, Bayle.

Distr.—3 sp. (or varieties?). Australia. Fossil, 100 sp. Devonian—; Europe, United States, Chili, Algeria, Cape, South India. *T. pectinata*, Lam. (cxxv, 18).

Shell thick, tuberculated, or ornamented with radiating or concentric ribs; posterior side angular; ligament small and prominent; hinge-teeth 2·3, diverging, transversely striated; centre tooth of left valve divided; pedal impressions in front of the posterior adductor, and one in the umbo of the left valve; anterior adductor impression close to the umbo.

Animal with a long and pointed foot, bent sharply, heel prominent, sole bordered by two crenulated ridges; palpi small and pointed; gills ample, the outer smallest, united behind the body to each other and to the mantle.

The shell of *Trigonia* is almost entirely nacreous, and usually wanting or metamorphic in limestone strata; casts of the interior are called "horse-heads" by the Portland (England) quarrymen; they spoil the stone. Silicified casts have been found at Tisbury, in which the animal itself, with its gills, was preserved. The species with the posterior angle of the shell elongated have a siphonal ridge inside. The epidermal layer of the recent shell consists of nucleated cells, forming a beautiful microscopic object. A *Trigonia* placed by Mr. S. Stutchbury on the gunwale of his boat leapt overboard, clearing a ledge of four inches; they

are supposed to be migratory, as dredging for them is very uncertain, though they abound in some parts of Sydney Harbor.

Trigoniæ appeared in Devonian and Liassic strata, became numerous in the Jurassic and Cretaceous, and have since continued to decline. Australia, where so many others of earth's oldest forms continue to exist, furnishes the only living species.

Trigoniæ are divided according to form and sculpture into several sections, all of which are extinct except the last.

Scaphoidea. *T. navis*, Lam. (cxxxv, 19). Lias; Alsace.

Undulataæ. *T. undulata*, Fromh. Jura.

Costataæ. *T. costata*, Lam. (cxxxv, 20). Oolite; Switzerland.

Glabræ. *T. longa*, Agassiz (cxxxv, 21). Neocomian; Neufchatel.

Quadrataæ. *T. Parkinsonii*, Agassiz (cxxxv, 22). Portlandian; Besançon.

Scabræ. *T. scabra*, Lam. (cxxxv, 23). Cretaceous.

Byssiferaæ. *T. carinata*, Agass. Neocomian.

Clavellataæ. (*Myophorella*, Bayle.) *T. clavellata*, Sowb. Jura.

Pectinataæ. *T. pectinata*, Lam. Australia (living).

SCHIZODUS, King, 1848.

Syn.—Axinopsis, Tate. Megalodus (part), Goldf.

Distr.—Fossil, 20 sp. Upper Silurian—Muschelkalk; United States, Europe. *S. Schlotheimi*, Geinitz (cxxxvii, 56).

Shell trigonal, rounded in front, attenuated behind; rather thin, smooth, with an obscure, oblique ridge; ligament external; hinge-teeth 2·3, smooth, rather small; anterior adductor slightly impressed, removed from the hinge, with a pedal scar close to it; pallial line simple.

NEOSCHIZODUS, Giebel, 1856. Shell similar to Schizodus; hinge of the left valve with a large posterior, subterminal, cardinal tooth, posteriorly prolonged, parallel to the fulcrum, which are distinct from the margin itself, and with an anterior terminal cardinal; right valve with a marginal elongated posterior and a subterminal shorter, but thicker, anterior cardinal tooth. *S. lævigatus*, Giebel. Triassic; Germany.

MYOPHORIA, Bronn, 1830. (*Cryptina*, Boue.) Shell trigonal, umbones turned forwards; obliquely keeled; smooth or sculptured; teeth 2·3, striated obscurely, centre tooth of left valve simple, anterior of right valve prominent; mould like Trigonia. *M. decussata*, Munst. (cxxxvii, 57), has a lateral tooth at the dorsal angle of the left valve. Fossil, 16 sp. Trias; Germany, Tyrol.

PRISCONAIA, Conrad, 1867. Shell ovate; hinge in the left valve with two cardinal teeth, the anterior compressed, angular, oblique, with an anterior pit; the posterior broad, smooth, convex, triangular, situated under the beak and directed posteriorly. emarginated at its end; no lateral teeth; muscular impression

situated near the cardinal line. Type, *P. ventricosa*, Con. (cxxiv, 98). Carboniferous; Kansas. This genus, Conrad says, bears the same relation to Carbonicola that Margaritana bears to Unio. Mr. Meek says, "I differ from Mr. Conrad in regard to the relations of Priscoana; I think it belongs to the Trigoniidæ, near Schizodus—if not the same."

REMONDIA, Gabb, 1869.

Distr.—*R. furcata*, Gabb (cxxxvii, 58, 59). Cretaceous; Mexico. *R. Bronnii*, Krauss. Cretaceous; So. Africa.

Shell compressed, elongately subquadrate, inequilateral, the beaks being subanterior; ligament very short, external; hinge composed of three moderately diverging, elongated cardinal teeth and one long posterior lateral in the left valve; those of the right would appear to be similar and corresponding to those of the left. The middle cardinal of the left valve is transversely striated, as in Trigonina, and is slightly grooved on its face; the anterior is linear and smooth, and the posterior is also smooth, at least on its posterior face. In the right valve the anterior tooth is as large as the middle, the posterior is linear.

? ISCHYRINA, Billings, 1866.

Distr.—Fossil, 2 sp. Silurian; Anticosti. *I. Winchelli*, Billings.

Shell equivalve, inequilateral, two strong ridges radiating from the beak in the interior of each valve.

CURTONOTUS, Salter, 1863.

Distr.—Fossil, 6 sp. Devonian; Britain. *C. elongatus*, Salter (cxxv, 24).

Shell elongately ovate; having a thickened hinge-plate, with a single strong triangular central tooth on each valve. Right valve plate with an obscure tooth behind the central one. Anterior muscular scar deep; pallial impression entire.

It seems very closely allied to Schizodus, but has not the broad median emarginated tooth in the left valve fitting into a special pit of the right valve; the forms of Curtonotus are also much more regularly oval.

DOLABRA, M'Coy, 1844.

Distr.—*D. corrugata*, M'Coy. Carboniferous; Ireland.

Shell ovate or trapezoid, gibbose, with a more or less straight hinge-margin, inequilateral, inequivalve, the left valve being larger than the right, hinge posteriorly with an elongated tooth, sometimes bifid in the left valve.

(Arcacea.)

FAMILY NUCULIDÆ.

Shell oval or trigonal, small, nacreous within; hinge composed of a great number of transverse teeth, interrupted by a central pit for the reception of the ligament, which is internal or external.

NUCULA, Lam.

Etym.—Diminutive of *nut*, a nut.

Syn.—Polydonta, Muhl. Nuculites (part), Conrad.

Distr.—50 sp. Northern and Arctic seas; 10–180 fathoms. Siberia, Melville Island, New England, Britain, Mediterranean, Cape, Japan, Australia. Fossil, 250 sp. (50 Palæozoic, 30 Trias, 70 Cretaceous, 100 Tertiary.) United States, Europe, South India. *N. obliqua*, Lam. (cxxvi, 27).

Shell trigonal, with the umbones turned towards the short posterior side; smooth or sculptured, epidermis olive, interior pearly margins crenulated; hinge with prominent internal cartilage-pit, and a series of sharp teeth on each side; pallial line simple.

Animal with the mantle open, its margins plain; foot large, deeply fissured in front, forming when expanded a disk with serrated margins; mouth and lips minute, palpi very large, rounded, strongly plaited inside and furnished with a long convoluted appendage; gills small, plume-like, united behind the foot to the branchial septum.

The *Nucula* uses its foot for burrowing, and Professor Forbes has seen it creep up the side of a glass of sea-water. The labial appendages protrude from the shell at the same time with the foot.

ACILA, H. and A. Adams, 1858. Valves divaricately sculptured. 3 recent species. *N. divaricata*, Hinds (cxxvi, 28). Fossil. *N. ornatissima*, d'Orb. (cxxvi, 29). Cretaceous.

LEDA, Schumacher, 1817.

Etym.—*Leda*, in Greek mythology, mother of Castor and Pollux.

Syn.—Lembulus (Leach), Risso. Nuculana, Link. Daeryomya, Agass. Jupiteria, Bellardi. Junonia and Saturnia, Seguenza.

Distr.—80 sp. Northern and Arctic seas; 10–180 fathoms. Siberia, Melville Island, New England, Britain, Mediterranean, Cape, Japan, Australia. Fossil, 190 sp. Silur.—; United States, Europe, South India. *L. pernula*, Müll. (cxxvi, 31).

Shell resembling *Nucula*; oblong, rounded in front, produced and pointed behind; margins even; pallial line with a small sinus; umbonal area with a linear impression joining the anterior adductor.

Animal furnished with two partially united, slender, unequal, siphonal tubes; gills narrow, plume-like, deeply laminated, attached throughout; mantle-margin with small ventral lobes forming by their apposition a third siphon.

ADRANA, H. and A. Adams, 1858. Shell thin, gaping at the extremities. *L. Sowerbyana*, d'Orb. (cxxxvi, 32).

NEILONELLA, Dall, 1881. Shell not gaping, epidermis polished, ligament central. *L. corpulenta*, Dall. Havana.

PERRISONOTA, Conrad, 1869. Shell elongated, posterior hinge-line long, curved, linear, with numerous close transverse teeth, extending nearly to the end margin; anterior hinge-area broad, oblique, and somewhat distant from the hinge-margin; no fosset under the apex? *L. protexta*, Con. Cretaceous; New Jersey.

YOLDIA, Möller, 1832.

Etym.—Dedicated to the Countess Yoldi.

Distr.—Arctic and Antarctic seas, Greenland, Massachusetts, Brazil, Norway, Kamtschatka. *Yoldia limatula* has been dredged alive, by Mr. M^dAndrew, on the coast of Finmark. It is also found in Portland Harbor, Maine. Fossil; Silur.—*Y. myalis*, Couch. (cxxxvi, 33).

Shell oblong, slightly attenuated behind, compressed, gaping, smooth or obliquely sculptured, with dark olive shining epidermis; external ligament slight; cartilage as in *Leda*; pallial sinus deep.

Animal (cxxxvii, 61) with the branchial and anal siphons united, retractile; palpi very large, appendiculate; gills narrow, posterior; foot slightly heeled, deeply grooved, its margins crenulated; intestine lying partly close to the right side of the body, and producing an impression in the shell; mantle-margin plain in front, fringed behind; destitute of ventral lobes. The animal is very active, and leaps to an astonishing height, exceeding in this faculty the scollop-shells.

PORTLANDIA, Mörch. Valves posteriorly closed.

PHASELOTUS, Jeffreys. Like *Yoldia*, but teeth less numerous, moderately long, oblique, in two diverging rows. Recent and Pliocene.

MALLETIA, Desmoulins, 1832.

Syn.—*Solenella*, Sowb., 1832. *Ctenoconcha*, Gray, 1840.

Distr.—2 sp. Valparaiso; New Zealand. *M. Chilensis*, Desm. (cxxxvi, 34). Fossil sp. Miocene; Point Desire, Patagonia; Italy.

Shell oval, compressed, smooth or concentrically furrowed, epidermis olive; ligament external, elongated, prominent; hinge with an anterior and posterior series of fine sharp teeth; interior subnaercous; pallial sinus large and deep; anterior adductor giving off a long oblique pedal line.

Animal like *Yoldia*; mantle-margins slightly fringed and furnished with ventral lobes; siphonal tubes united, long, and slender, completely retractile; palpi appendiculated, convoluted, as long as the shell; gills narrow, posterior; foot deeply cleft; forming an oval disk, even-margined and striated across.

NEILO, H. and A. Adams, 1855. Shell transverse, gaping, sub-truncated, rostrated behind; surface concentrically striated; not nacreous within; cardinal hinge-line nearly straight. *M. Cumingii*, A. Adams (cxxvi, 35). Recent. *M. Monterosati*, Bell. Miocene; Italy.

TINDARIA, Bellardi, 1875. Shell thick, globose, oval, closed, beaks swollen; anterior teeth stronger, but the posterior row longer. *M. arata*, Bell. Pliocene; Asti, Italy.

NUCULARIA, Conrad, 1869. Shell thin, not pearly, ovately elongated, inequilateral, smooth; beaks pointed, subanterior; teeth angular, those of the posterior line complicated. *M. papyria*, Conrad (cxxvi, 36). Cretaceous; Haddonfield, N. J.

PHTHONIA, Hall, 1869.

Distr.—2 sp. Fossil; Hamilton Group, N. Y. *P. sectifrons*, Conrad (cxx, 8).

Shell thin, compressed, equivalve, transversely elongate-ovate, widening posteriorly and having small obscure subanterior beaks and an obscure angular umbonal ridge; surface covered by more or less distinct radiating striæ or costæ, which are crossed and cancellated by finer concentric lines, often forming rugæ or node-like markings on the rays; hinge apparently destitute of teeth; external ligament small, elongated; adductors small, superficial, pallial line apparently entire.

PALEONEILO, Hall, 1870.

Distr.—15 sp. Palæozoic; U. S. *P. constricta*, Conr. *P. Bedfordensis*, Meek (cxxv, 25).

Shell Nuculiform, transversely ovate or subelliptical, the posterior end extended, often subrostrate, with a more or less defined sulcus along the umbonal slope; concentrically striated or ribbed; hinge-line more or less arcuate, crenulated throughout, not interrupted beneath the beak by a ligamental pit, but having an external ligament; muscular scars distant, faintly marked; several small pedal scars within the umbonal cavity; pallial line simple or obliquely truncate posteriorly.

Differs from *Nucula* in the want of a ligamental pit, in the teeth being continuous under the beaks, in having an external ligament, and in the sulcus on the posterior slope.

NUCULITES, Conrad, 1841.

Syn.—*Cucullella*, M'Coy, 1851. *Cleidophorus*, Hall, 1847.

Distr.—Silurian; New York, Europe. *N. ovatus*, Sowb. (cxxxvii, 62).

Shell thin, margins not crenulated, ligament external; no cartilage-pit; teeth numerous, on a nearly straight cardinal line; anterior muscular scar bounded by a ridge; pallial line simple.

Cleidophorus, Hall, has been considered a synonym by Dr. Meek, who says that "the type species is now known to have a crenate hinge like *Nucula*," although the original description makes it toothless.

NYASSA, Hall, 1869.

Syn.—Modioconcha, Hall, 1869.

Distr.—4 sp. Palæozoic. *N. arguta*, Hall. Devonian; Ohio, New York.

Valves very oblique and transversely ovate in form; posterior hinge-plate narrow, bearing from one to four long slender ridge-like teeth; anterior plate broad, marked by numerous small, point-like teeth with intermediate depressions, arranged somewhat radiating from the middle of its inner border; adductor muscles two, one at each extremity; pallial line entire; ligament internal.

PTYCHOSTOLIS, Tullberg, 1881.

Distr.—Jurassic; Nova Zembla.

Shell obliquely oval; hinge-plate short with about eight denticles; anterior to the beaks a deep lunule, behind them a small escutcheon; under the last the margin of the shell forms two folds, forming a chamber communicating with the interior of the shell.

PHOLADELLA, Hall, 1869.

Distr.—5 sp. Fossil; Hamilton and Chemung Groups, N. Y.; Waverly Sandstones, Ohio. *P. radiata*, Conr.

Shell equivalve, inequilateral, transversely elongated, with more or less inflated valves, and strong, somewhat tumid incurved beaks situated near the anterior end. Valves crossed by a more or less distinct antero-mesial sinus constricting the basal margins, and also by a somewhat prominent umbonal ridge. Cardinal margin inflected, forming a more or less distinctly defined escutcheon and anterior lunette. Hinge characters and muscular impressions unknown; ligament external? Surface ornamented by oblique radiating ribs or striæ, which are mostly confined between the anterior prominence and the posterior umbonal ridge; while the anterior end and sometimes the posterior cardinal slope are without radii.

CIMITARIA, Hall, 1869.

Distr.—3 sp. Fossil; Hamilton Group, N. Y. *C. corrugata*, Conr. (cix, 88).

Shell bivalve, equivalve, inequilateral, transversely elongated, and more or less recurved with depressed convex valves, which have an antero-mesial constriction, slightly angular umbonal, and somewhat prominent incurved subanterior beaks; cardinal line recurved, bordered by a narrow escutcheon and lunette; posterior end truncate and usually nearly rectangular to the posterior part of the cardinal line. Surface marked by moderately strong irregular concentric undulations on the anterior end, which extend to the umbonal ridge and sometimes continue vertically across the cardinal slope. Some species are likewise marked by fine radiating lines of pustules on the body of the shell. Cardinal slope often marked by one or more radiating ridges; valves united by an external ligament. Hinge-teeth and muscular impressions undetermined.

? *DYSTACTELLA*, Hall and Whitfield, 1872.

Type, *Tellinomya subnasuta*, H. and W. Fossil; U. Helderberg, Kentucky.

Shell unequally ovate, twice as long as high, with very ventricose valves, giving a subcylindrical form anterior to the beaks; posterior end very narrow, pointed at the extremity; anterior end broadly rounded, longest above the centre, basal line very slightly insinuated, beaks small, appressed, at two-thirds the entire length from the anterior extremity; muscular impressions moderate in size, distinctly marked, situated near the margins; pallial line entire, composed of a series of radiating pustules, as seen on the cast; crenulations of the hinge not distinctly seen, but the evidence possessed would indicate them to have been minute.

FAMILY ARCIDÆ.

Shell regular, equivalve, with strong epidermis; ligament exterior, occupying an area between the beaks; hinge with a long row of similar, comb-like teeth; pallial line distinct; muscular impressions subequal. Structure corrugated, with vertical tubuli in rays between the ribs or striæ—CARPENTER.

Animal with the mantle open; foot large, bent, and deeply grooved; gills very oblique, united posteriorly to a membranous septum.

ARCA, Linn.

Etym.—*Arca*, a chest.

Syn.—*Navicula*, Blainv., 1818. *Byssoarca*, Swains., 1840. *Daphnæoderma*, Poli, 1792.

Distr.—140 sp. World-wide, most abundant in warm seas; low water—230 fathoms (*A. imbricata*, Poli). Prince-Regent Inlet (*A. glacialis*). Fossil, 400 sp. Lower Silurian—; United States, Europe, South India. *A. Noæ*, Linn. (cxxxvi, 39).

Shell equivalve or nearly so, thick, subquadrate, ventricose, strongly ribbed or cancellated; margins smooth or dentated, close or sinuated ventrally; hinge straight, teeth very numerous, transverse; umbones anterior, separated by a flat, lozenge-shaped ligamental area, with numerous cartilage-grooves; pallial line simple; posterior adductor impression double; pedal scars two, the posterior elongated.

Animal with a long pointed foot, heeled, and deeply grooved; mantle furnished with ocelli; palpi 0; gills long, narrow, less striated externally, continuous with the lips; hearts two, each with an auricle.

The name *Byssoarca* was chosen unfortunately by Swainson, for the typical species of the genus, in which the byssal orifice is sometimes very large. The byssus is a horny cone, composed of numerous thin plates, occasionally becoming solid and calcareous; it can be cast off and reformed with great rapidity. The *Arcas* with close valves often have the left valve a little larger than the right, and more ornate.

The *Byssoarks* secrete themselves under stones at low-water, in crevices of rocks, and the empty burrows of boring mollusks; they are often much worn and distorted.

A large number of genera and subgenera have been formed out of the Linnæan *Arca*, but as in *Helix*, *Murex* and other well-known and well-characterized groups, these groups possess but slight value; the most important of them may be considered subgenera, perhaps; others as sections.

ARCA, Linn. (typical). Shell oblong, subquadrangular, gaping anteriorly or inferiorly; hinge linear, straight, formed of a large number of small pectinated teeth; ligament external, inserted upon a lozenge-shaped area between the beaks; beaks high, rather wide apart; muscular impressions very distinct; pallial impression entire. *A. Noæ*, Linn. The *Arcas* often anchor themselves by means of a strong byssus to rocks or stones.

BARBATIA, Gray, 1840. Shell oblong, oval or subquadrangular; surface covered by a rude, caducous epidermis; hinge-line straight or somewhat curved; teeth numerous, the central ones smallest, the lateral ones becoming gradually larger and more oblique towards the extremities; ligament external, inserted upon a narrow surface between the approaching beaks. *A. velata*, Sowb. (cxxxvi, 40).

POLYNEMA, Conrad, 1875. Shell transversely trapezoid-ovate, narrowing anteriorly; cardinal margin descending forward, and meeting the anterior and posterior margins at more or less defined angles; cardinal area extremely narrow, with about two deep, divaricating cartilage-furrows; lateral denticles very oblique, those on the posterior side more elongated and striated;

surface with fine radiating striæ. *Barbatia lineata*, Conrad (cxxvii, 65). Cret.; North Carolina.

ACAR, Gray. Valves cancellate or costellate; posterior slope subcarinated or angulated. *A. Donaciformis*, Reeve (cxxxvi, 41).

CALLOARCA, Gray, 1857. Shell with the posterior slope strongly carinated, and that and the anterior slope both strongly ribbed, the ribs forming marginal teeth within. *A. alternata*, Reeve (cxxxvi, 42).

STRIARCA, Conrad, 1862. Shell oblong, with a depression running from the beak to the ventral margin, which is somewhat insinuated, no doubt corresponding to a small gape; the surface is radiately striated; the ligamental area and hinge-teeth are quite similar to those of *Barbatia*. *A. centenaria*, Say (cxxvii, 66, 67). Miocene; U. S.

PLAGIARCA, Conrad, 1875. Shell transversely trapezoidal, with hinge nearly straight, and meeting the lateral margins at more or less defined angles; lateral denticles very oblique, one or two of the anterior series being comparatively large and slightly angulated in the middle; surface radiately costate; area very narrow, and marked by numerous minute, crowded, divaricating cartilage-furrows. *Arca Carolinensis*, Conr. (cxxvii, 79). Cret.

GRANOARCA, Conrad, 1862. (Cucullæarca, Conrad, 1865.) Equivalve, gaping anteriorly; hinges rather wide and very oblique, with longitudinal grooves angulated under the back; tooth more or less divided into granular plates, posteriorly widely expanded and broken into irregular granules. *A. propatula*, Conr. (cxxxix, 5). Miocene; U. S.

LITHARCA, Gray, 1840. Shell cuneiform, obliquely truncated behind, elongated and rounded in front, gaping inferiorly; no teeth behind the beaks. *A. lithodomus*, Sowb. (cxxvii, 68). Recent.

ANOMALOCARDIA, Klein, 1753. (Anadara, Gray, 1847.) Shell thick, subcordiform or subquadrangular, equivalve, subequilateral; valves radiately costate, with a smooth or rugose olive epidermis; hinge-line nearly straight, with numerous teeth, smallest in the middle, largest at the extremities. Differs from *Barbatia* principally in form. *A. auriculata*, Lam. (cxxxvi, 43).

SCAPHARCA, Gray, 1847. Shell oval or oblong or subquadrangular, thin, radiately ribbed, with a light epidermis; inequivalve, one valve overlapping the other considerably on the inferior margin; teeth subequal, dilated, more or less oblique. *A. inequivalvis*, Brug. (cxxxvi, 44).

NEMOARCA, Conrad, 1869. Shell elongately trapezoidal, subequilateral, tumid, radiately ribbed; ligamental area narrow; hinge-line straight, with small transverse teeth. *A. cretacea*, Conrad (cxxxvi, 48).

SENILIA, Gray, 1847. Shell thick, solid, triangular, subcordiform, subequilateral, equivalve; surface with a few large, flat, radiating

ribs, and narrow intervening furrows; epidermis smooth, olive; teeth large, oblong, arcuated on each side. *A. senilis*, Linn. (cxxxvi, 45).

ARGINA, Gray, 1840. Shell subglobose, subcordiform, equi-valve, inequilateral; covered with radiating ribs and a brown, hairy epidermis; teeth numerous, elongated, curved, the central ones very small. *A. pexata*, Say (cxxxvi, 46, 47).

ISOARCA, Münster, 1842. Shell ventricose; beaks large, anterior, often subspiral; ligament entirely external; hinge-line curved, with transverse teeth, smallest in the centre; pallial line simple. *I. Logani* (Ctenodonta), Salter, Lower Silurian, Canada, is 3 inches long, and has the ligament preserved. Fossil, 14 sp. Lower Silurian—Cretaceous; North America, Europe. *I. texta*, Münster. (cxxxvii, 69).

CARBONARCA, Meek and Worthen, 1875. Shell (as determined from internal casts) equi-valve, inequilateral, very convex, transversely oblong or oval; umbones gibbous, prominent, and strongly incurved with subangular or prominent posterior slopes; valves closed all around, with smooth margins; ligament external; cardinal margin a little arched, with, at the anterior extremity in each valve, two rather oblique comparatively stout teeth, and extending along its entire length from immediately behind these, a row of minute, interlocking teeth or crenulations as in *Arca*. *C. gibbosa*, M. and W. (cxxxvii, 71). Upper Coal-measures, Ills.

LUNARCA, Gray, 1842. Shell globose, subcordiform, nearly equi-valve; surface radiately costate, with brown, foliaceous epidermis; hinge with the posterior tooth elongated; narrow in the middle; the front tooth of the left valve ovate; elevated, entire, fitting into a cavity in the inner edge of the front margin of the right valve. *A. costata*, Gray (cxxxvi, 49).

NOETIA, Gray, 1842. Shell trigonal, ventricose, inequilateral, equi-valve; posterior side truncate, strongly angulate; teeth smallest in the middle, anteriorly elongated, posteriorly arcuated. *A. ponderosa*, Say (cxxxviii, 84, 85).

GLYPTARCA, Hicks, 1872. Inequilateral, strongly ventricose; beak near the anterior end, prominent, overhanging the hinge-line more or less and pointed at the extremity; two diverging ridges extend from the umbo to the margin, and enclose a triangular sulcus, having its base at the margin, which it thereby indents; anterior muscular impression strong, posterior less distinct; hinge-area narrow, plate thick, with three teeth in front of the umbo; surface strongly marked with growth-lines. 2 sp. Silur.; Wales. *A. primæva*, Hicks (cxxxvi, 37, 38).

MACRODON, Lycett, 1845.

Syn.—Parallelodon, Meek and Worthen, 1866. *Chic. Ac. Proc.*

Distr.—Oolite—Recent. *M. asperula*, Dall. Yucatan. Fossil. *M. Hirsonensis*, d'Arch. (cxxxvii, 72).

Shell thick, subrhomboidal, beaks anterior; hinge with a few oblique anterior teeth, and one or more long, laminar posterior teeth, parallel with the hinge-line.

CUCULLARIA, Deshayes, 1860. Shell elongated, suboval, moderately inflated, radiately striated, inequilateral, beaks subanterior, incurved, very close together, the hinge-area being very narrow and almost wanting in some species; hinge-line moderately curved with a few shorter anterior and some longer posterior fold-like teeth, arranged almost parallel to it; numerous subequal teeth are situated below the beaks. *Arca heterodonta*, Desh. (cxxvii, 80, 81). From the Paris Basin.

NEMODON, Conrad, 1869. Shell elongated, form resembling *Macrodon*, but of thin structure; hinge-area very narrow, hinge-line long, straight, or slightly curved under the beaks, "with three linear teeth parallel with the anterior cardinal margin" in the left valve, and with a double posterior lateral tooth, being very long and linear; under the beaks a few granular teeth are present. *M. Eufalensis*, Conrad (cxxvi, 50, 51). Scarcely distinct from the typical *Macrodon*.

GRAMMATODON, Meek and Hayden, 1860. Appears to be distinguished only by the posterior muscular impression not being raised upon a projecting lamina. Jurassic; U. S. Type, *M. inornata*, M. and H.

PARALLELOPIPEDUM, Klein, 1753.

Distr.—2 sp. China. *P. tortuosum*, Lam. (cxxvii, 73).

Shell subquadrangular or mytiliform, subequivalve, carinated, twisted so that the straight hinge-line is oblique instead of transverse to the beaks; teeth numerous, middle ones smallest, lateral ones larger and oblique.

SCAPHULA, Benson, 1834.

Distr.—Fresh water, India, Burmah.

Shell thin, elongated, subtrapeziform, equivalve, very inequilateral, carinated behind; valves covered with a thin, smooth epidermis; hinge edentulous in the centre, posterior teeth laminar and branched.

S. pinna, Benson (cxxvi, 52), is found in the Ganges and its branches, from Calcutta to Humeerpoor on the Jumna, 1000 miles from the sea. A second species has been found in the river Tenasserim, Burmah.

CUCULLÆA, Lamarek, 1801.

Etym.—*Cucullus*, a cowl.

Distr.—2 sp. Mauritius, Nicobar, China. Fossil, 240 sp. Lower Silurian; North America, Patagonia, Europe. *C. concamerata*, Mart. (cxxvii, 74).

Shell subquadrate, ventricose; valves close, striated; hinge-teeth few and oblique, parallel with the hinge-line at each end; posterior muscular impression bounded by an elevated ridge.

IDONEARCA, Conrad, 1862. Shell thicker than the type, with a wider hinge-plate and fewer of the short mesial denticles, which are prominent and transversely striated; lateral denticles long, horizontal, or descending outward, and bent downward at the inner ends, strongly cross-striated; laminae of posterior muscular scars prominent. Cretaceous; Amer. and Eur. *Cucullæa Tippana*, Conr.

LATJARCA, Conrad, 1862. Shell very thick and strong; hinge comparatively narrow, and occupied by very irregular, strong, vertical denticles, excepting at each end, where it is broad, and occupied by strong, rugosely-striated, longer denticles, declining outward, and bent downward at the inner ends; posterior muscular scars, with their lower margins somewhat raised and acute, but not forming a projecting lamina. *Cucullæa onoclea*, H. D. and W. B. Rogers. Eocene.

TRIGONARCA, Conr., 1862. Shell subtrigonal or subtrapezoidal, with posterior margin obliquely truncated, and posterior basal extremity more or less angular; posterior umbonal slopes prominently rounded or angular; hinge-area divaricately furrowed; hinge-teeth rather strong. *C. triquetra*, Conr. (cxxxix, 6).

BREVIARCA, Conr., 1872. Shell small, suborbicular or suboval, more or less rounded at the extremities, or rarely truncated obliquely behind; surface nearly smooth, or finely radiately striated; hinge-area with minute cross-striae; hinge-denticles very fine and crowded. *C. perovalis*, Conrad (cxxxvii, 82). Cretaceous.

CYPRICARDITES, Conrad, 1841; Hall, 1868.

Syn.—Cyrtodonta, Vanuxemia, Billings, 1858. Palæarca, Hall, 1859.

Distr.—60 sp. Silurian, Devonian; N. America, Wales.

Shell ventricose, suborbicular or broad-ovate in outline, with an external flattened ligamental area; cardinal teeth four to five, short, oblique; lateral teeth two or more, oblique; muscular impressions two (anterior one single?); pallial line simple.

MEGALOMUS, Hall, 1852. Shell ventricose, ponderous; beaks strong, incurved, anterior; hinge-plate with several oblique tuberculose teeth at the anterior end, subject to absorption; lateral teeth none; ligament external; anterior muscular scar double, one large and deep, the other minute; posterior scar very large, obscure; pallial line simple. Palæozoic; U. S. *C. Canadensis*, Hall (cxxxix, 7). See p. 207. The genus is better placed here, and the above description is the most correct.

ÆGILOPS, Hall, 1850. Described from a cast, impossible to determine. Has the form of Cypricardites.

MEGAMBONIA, Hall, 1859. Shell ventricose, broad-ovate or suborbicular; anterior end with a ventricose wing or extension, separated from the body of the shell by a deep curved sinus; anterior hinge-teeth unknown; lateral teeth two to three, short, small and oblique; ligamental area narrow or obsolete; anterior muscular scar deep, circular, and having a small pedal scar upon its upper margin; posterior scar larger, faintly impressed; pallial line simple. *C. aviculoidea*, Hall (cxxxix, 9).

ADRANARIA, Munier-Chalmas, 1876.

Syn.—Siliquarca, Pseudarca, Tromelin and Lebesq.

Distr.—2 sp. Palæozoic; France. *A. Tromelini*, M.-C.

Shell equivalve, recalling *Cultellus* by its general form; hinge with a series of oblique linear, nearly parallel teeth, the anterior ones narrower and more divergent, the posterior more numerous; a rib within each valve passes in front of the anterior muscular impression.

CARDIOLA, Broderip, 1834.

Distr.—17 sp. U. Sil.—Devon.; Eur., U. S. *C. cornucopiæ*, (cxvi, 94).

Shell somewhat inequilateral or subequilateral, roundly ovate, with the beaks incurved anteriorly and with a rather large ligamental area between both; hinge-line slightly curved with numerous oblique pliciform teeth, being apparently present on both sides of the beak; surface generally radiately striated or ribbed.

LYRODESMA, Conrad, 1841.

Syn.—Actinodonta, Phil.

Distr.—Fossil, 4 sp. Lower Silurian; Canada, United States, Britain. *L. pulchella*, Hall (cxxxvii, 83).

Shell Trigonion-shaped, rather elongated, with a striated posterior area; hinge with several (5–9) radiating teeth, striated across; ligament external.

Lyrodesma appears to connect the *Pectunculus* with the *Arcinæ*.

PECTUNCULUS, Lam.

Syn.—Axinæa, Poli, 1791. *Tuceta*, Bolten.

Distr.—58 sp. West Indies, Britain, India, New Zealand, West America; ranging from 8 to 60, rarely 120 fathoms. Fossil, 80 sp. Neocomian—; Europe, United States, South India. *P. Delesserti*, Reeve (cxxxvii, 53).

Shell orbicular, nearly equilateral, smooth or radiately striated; umbones central, divided by a striated ligamental area; hinge with a semicircular row of transverse teeth; adductors subequal; pallial line simple; margins crenated inside.

Animal with a large crescent-shaped foot, margins of the sole

undulated; mantle open, margins simple, with minute ocelli; gills equal, lips continuous with the gills.

The teeth of *Pectunculus* and *Arca* increase in number with age, by additions to each end of the hinge-line, but sometimes the central teeth are obliterated by encroachments of the ligament.

CNISMA, Mayer. Small, obliquely oval, very inequilateral, margin smooth; hinge very thick, with three anterior and four posterior teeth. *P. nukulatus*, Lam. Eocene.

LIMOPSIS, Sassi, 1827.

Syn.—*Pectunculina*, d'Orb., 1844.

Distr.—5 sp. Red Sea (Nyst.), Japan, Britain. Mr. M'Andrew has dredged *L. pygmæa*, living, on the coast of Finmark; it is a fossil of the Pliocene of England, Belgium and Sicily. Fossil, 36 sp. Trias—; United States, Europe. *L. complanata*, Orb. (cxxxvii, 75). *L. alter*, Desh. (cxxxvii, 76). *L. Gyssei*, Raincourt (cxxx, 36, 37).

Shell orbicular, convex, slightly oblique; ligamental area with a triangular cartilage-pit in the centre; hinge with two equal, curved series of transverse teeth.

TRIGONOCÆLIA, Nyst., 1836. (*Trinacria*, Mayer.) Shell approaches *Leda* in form, and differs from *Limopsis* in the absence of the expanded ligamental area. Fossil, 7 sp. Eocene; Paris Basin, Belgium, England, United States. *L. inequivalvis*, d'Orb. (cxxxvii, 77).

CYRILLA, A. Adams. (*Huxleya*, A. Adams, 1860.) Shell oblong, oblique, very inequilateral, covered with a thin epidermis; hinge with six diverging, sharp teeth, directed posteriorly, and terminating with a curved lamina; ligament situated in a small pit under the beak. *L. sulcata*, H. Ad., from the Straits of Korea, dredged from 63 fathoms.

NUCUNELLA, d'Orb., 1850.

Syn.—*Nuculella*, Chenu. *Stalagmium*, Nyst. (in part).

Distr.—*N. Nysti*, Galeotti (cxxxvii, 54, 55). Tertiary; Belgium.

Shell suborbicular, slightly inequilateral, beaks close together; hinge-line curved, with numerous cross-pliciform teeth, interrupted under the beaks by an oblique, simply granular pit, this last appearing to have been for the ligament, which must at least have been partially internal.

? CYTHERODON, Hall, 1873.

Distr.—4 sp. Palæozoic; Hamilton Group, U. S. *C. (Nuculites) appressus* Conr. (cxxxvii, 63, 64).

Shell subtrapezoidal, with prominent beaks and posteriorly

angulate like *Cucullæa*; hinge with about four cardinal teeth in the right and five in the left valve.

CTENODONTA, Salter, 1851.

Syn.—*Tellinomya*, Hall.

Distr.—Fossil, 40 sp. Silurian—Carboniferous; Europe, N. America, Bolivia. *C. pectunculoides*, Hall (cxxvi, 30).

Shell elongately oval, subequilateral, smooth, or finely concentrically striate, valves moderately convex, hinge represented by two diverging comb-like denticulated margins without a special hinge-area between them and the beak, and below the latter, not interrupted by a pit; ligament apparently external, posterior to the beak.

From *Malletia* the shells would seem only to differ by a more elongated and more tumid form.

It is probable that most of the palæozoic species referred to *Nucula* belong to *Ctenodonta*.

TELLINOMYA, Hall, 1847. Has been considered a synonym of *Ctenodonta*; perhaps some species referred to it really belong here. Many of the palæozoic genera are very difficult to classify, because they are frequently not well-preserved, and the essential characters are consequently wanting. *T. nasuta*, Hall. 35 sp.

SAREPTA, A. Adams, 1860.

Distr.—*S. speciosa*, A. Ad. Japan.

Shell oval, equivalve, not pearly within; hinge-line nearly straight, provided with numerous denticles, cartilage internal, below the beak; muscular impressions distant, pallial line entire.

"This genus," says the author, "agrees with *Nucula* in the simple pallial line and internal ligament, and with *Malletia* in not being nacreous or pearly within, and in general form and character." Is possibly a recent representative of the fossil genus *Ctenodonta*.

CARDIOLARIA, Munier-Chalmas, 1876.

Distr.—*C. Barrandeï*, M.-C. Palæozoic; France.

Shell equivalve, thin and subcircular, convex; hinge with a series of teeth similar to *Nucula*, the posterior ones the smallest and most numerous; pallial line simple; anterior muscular impression more developed than the posterior.

NUCINELLA, S. Wood, 1848.

Syn.—*Nuculina*, d'Orb., 1844. Pleurodon, Wood, 1840.

Distr.—Fossil. *N. miliaris*, d'Orb. (cxxvii, 78).

Shell oval or subtrigonal, equivalve, inequilateral; hinge wide and curved, with sparse transverse teeth, and a long lateral tooth on the longer anterior side; muscular impressions unequal, the

anterior oval; pallial line simple; ligament external, contained in a very small pit.

SUBORDER *HETEROMYARIA*.

Frequently inequivalve; anterior muscular impression very small, posterior impression large.

(*Mytilacea*.)

FAMILY MYTILIDÆ.

Shell equivalve, oval or elongated, closed, umbones anterior, epidermis thick and dark, often filamentose; ligament internal, submarginal, very long; hinge edentulous; outer shell-layer obscurely prismatic-cellular; inner more or less nacreous; pallial line simple; anterior muscular impression small and narrow, posterior large, obscure.

Animal marine or fluviatile, attached by a byssus; mantle-lobes united between the siphonal openings; gills two on each side, elongated, and united behind to each other and to the mantle, dorsal margins of the outer and innermost laminæ free; foot cylindrical, grooved.

The members of this family exhibit a propensity for concealment, frequently spinning a nest of sand and shell-fragments, burrowing in soft substances, or secreting themselves in the burrows of other shells.

The Mytilidæ appear in the palæozoic strata, and continue in increasing variety and number of species to the present time.

SUBFAMILY *MYTILINÆ*.

Shell elongated with subterminal or terminal and pointed beaks; hinge toothless; anterior muscular-scar small, marginal, posterior scar large and elongated; pallial line entire.

MYTILUS, Linn., 1758.

Sea-mussel.

Distr.—65 sp. World-wide. Ochotsk, Behring's Sea, Russian Ice-meer; Black Sea, Cape Horn, Cape, New Zealand. Fossil, 100 sp. Silurian—; United States, Europe, South India. *M. smaragdinus*, Chemn. (cxxviii, 4).

Shell wedge-shaped, rounded behind, smooth in the typical species; umbones terminal, pointed; hinge-teeth minute or obsolete; pedal muscular impressions two in each valve, small, simple, close to the adductors.

Animal with the mantle-margins plain in the anal region, and projecting slightly; branchial margins fringed; byssus strong and coarse; gills nearly equal; palpi long and pointed, free.

The common edible mussel frequents mud-banks which are uncovered at low-water; the fry abound in water a few fathoms deep; they are full-grown in a single year. From some unknown cause they are at times extremely deleterious. The consumption of mussels in Edinburgh and Leith is estimated at 400 bushels (= 400,000 mussels) annually; enormous quantities are also used for bait, especially in the deep-sea fishery, for which purpose thirty or forty millions are collected yearly in the Frith of Forth alone.—Dr. KNAPP. Mussels produce small and inferior pearls. At Fort Stanley, Falkland Islands, Mr. Macgillivray noticed beds of mussels which were chiefly dead, being frozen at low-water.

The species of *Mytilus* are usually found attached by a byssus in masses to stones, wrecks or floating bodies. The ligulate grooved foot has the power of spinning the silky material of the byssus whenever the animal requires temporarily to anchor itself.

Boughs of elm and other trees are laid down in the Bay of Kiel, and taken up at the end of three, four, or five years, between December and March, being then covered with fine mussels. These laden boughs are sold by weight, and the shell harvest is sent into the interior of Germany, where it is in great request.

AULACOMYA, Mörch. (Hormomya, Mörch. *Arcomytilus*, Agass.) Surface ornamented with radiating ribs. *M. decussatus*, Lam. (cxxviii, 92).

CALROMYA, Mörch. *M. afer*, Gmel. (cxxxviii, 93).

MYTILOCONCHA, Conr., 1862. Subfalcate, thick, perlaceous, laminated; hinge thick, elongated; pointed at the apex; an oblique tooth or ridge and parallel furrow throughout the entire length of hinge-area. *M. incurva*, Conr. (cxxxix, 11).

BYSSOPTERIA, Hall, 1883. Shell erect, alate posteriorly, truncate with a nasute projection in front; surface radiated. *M. radiata*, Hall. Fossil; Chemung Group, N. Y.

MYTILOPS, Hall, 1883. Shell resembling *Modiola* and *Lithodomus* in external form, and may also be compared with the fossil genus *Myoconcha*; hinge-line narrow, oblique, extending about one-half the length of the shell; beaks terminal. 4 sp. Chemung Group, New York. *M. præcedens*, Hall.

STAVELIA, Gray, 1857. Shell inequivalve, inferior margin sinuous. *M. torta*, Dunker.

MODIOLA, Lam., 1799.

Etym.—*Modiolus*, a small measure, or drinking-vessel. Horse-mussel.

Syn.—*Perna*, Adanson, H. and A. Adams. *Amygdalum*, Muhlf. *Callitriche*, Poli.

Distr.—70 sp. Universal. Chiefly tropical. *M. modiolus*. Arctic seas—Britain. Fossil, 150 sp. Silurian? Lias—; United

States, Europe, Thibet, South India. *M. barbata*, Linn. (cxxxviii, 94). *M. tulipa*, Linn. (cxxxviii, 95).

Shell oblong, inflated in front; umbones anterior, obtuse; hinge toothless; pedal impressions three in each valve, the central elongated; epidermis often produced into long beard-like fringes.

Animal with the mantle-margin simple, protruding in the branchial region; byssus ample, fine; palpi triangular, pointed.

The Modiolæ are distinguished from the mussels by their habit of burrowing, or spinning a nest, using stones, fragments of shells and the byssal threads. The common American species, *M. plicatula*, however, adheres by its byssus in masses like *Mytilus*. Low-water—100 fathoms.

BRACHYDONTES, Swainson, 1840. Shell radiately ribbed, cardinal margin angular and sometimes crenulated. *M. plicatula*, Lam. (cxxxviii, 96).

ADULA, H. and A. Adams, 1855. Shell elongated, cylindrical, posterior margin obliquely truncated; beaks submedian. *M. Soleniformis*, d'Orbigny (cxxxix, 12).

MODIELLA, Hall, 1883. Subrhomboidal, narrowed and auriculate in front, broadly expanding posteriorly; two well-marked muscular impressions, connected by a simple pallial line; surface with radiating striæ. *M. pigmæa*, Conrad. Hamilton Gr., N. Y.

LITHODOMUS, Cuvier, 1817.

Syn.—Lithophaga, Bolten, H. and A. Adams. *L. caudigerus*, Lam. (cxxxviii, 97). *L. lithophaga*, Linn. (cxxxviii, 98).

Distr.—40 sp. West Indies—New Zealand. Fossil, 35 sp. Carb.—; Europe, United States.

Shell cylindrical, inflated in front, wedge-shaped behind; epidermis thick and dark; interior nacreous.

These mollusks, when young, suspend themselves to rocks by a byssus, but when adult they form cavities corresponding to the shape of their shells in soft rocks or other shells. *L. dactylus* is sold by the Mediterranean fishermen as an article of food, and is highly esteemed. Like other burrowing shell-fish, they are luminous. Perforations of *Lithodomi*, in limestone cliffs, and in the columns of the Temple of Serâpis at Puteoli, have afforded conclusive evidence of changes in the level of sea-coasts in modern times.

BOTULA, Mörch. Shell oblong, subrhomboidal, subcylindrical; beaks distant, subterminal. *L. splendida*, Dunker (cxxxix, 16).

LEIOSOLENUS, Carpenter, 1856. The cavity or burrow formed by the animal with the aperture prolonged into a tube, more or less bilobed at the outer end, contracted at the junction. *L. spatiosa*, Carpenter.

SUBFAMILY CRENELLINÆ.

Shell elongately tumid, thin, with subterminal slightly swollen beaks, two muscular scars, of which the posterior is larger, outer surface of valves entirely or partially radiately striated (except in *Myrina*); hinge-line often denticulate; ligament almost quite internal, in a linear groove, more or less extending posteriorly.

CRENELLA, Brown, 1827.

Etym.—Diminutive of *crena*, a notch.

Syn.—Myoparo, Lea, 1833. Stalagmium, Conr., 1833.

Distr.—5 sp. Low-water mark to 150 fathoms. Norway, Iceland, Greenland, New England, Britain, France. Fossil. Eocene; Ala. *C. rhombea* occurs in a fossil state in the Coralline Crag, England. *C. decussata*, Mont. (cxxix, 17).

Shell oval or rhomboidal, nacreous, cancellated; umbones straight, ligament small, hinge of each valve furnished with an upright tooth, which is crenulated, as well as the hinge-plate.

Animal with the mantle open in front, and folded behind into a sessile excurrent tube; foot cylindrical, the free end being disk-like and issuing out of a sheath. The animal does not spin a thick byssus, like *Modiolaria*, but secretes only a single thread for attachment, and by means of which it holds itself suspended in the water.

NUCULOCARDIA, d'Orb., 1843. Shell with large anterior crenate teeth, and smaller posterior ones. *C. divaricata*, d'Orb. (cxxix, 18).

DACRIDIUM, Torell, 1859. Hinge-crenulations tuberculiform anteriorly, elongate posteriorly. *D. vitrea*, Sars (cxxix, 19).

MODIOLARIA, Beck (Jeffreys, 1863).

Etym.—Allied to the genus *Modiola* of Lamarek.

Syn.—Lanistes, Humphreys. Lanistina, Gray.

Distr.—Temperate and Arctic seas. The four British species occur fossilized in the Red and Coralline Craggs and newer Tertiaries. Several species in the Upper Triassic and Jurassic formations, referred to *Modiola*, appear to belong here. *M. impacta*, Herm. (cxxviii, 99).

Shell rhomboidal, sculptured by two rows (one on each side) of striæ, which radiate from the beaks, leaving the middle portion smooth, umbones incurved, hinge edentulous or crenulated, hinge-plate finely notched.

Animal with the mantle folded in front into a wide incurrent tube, and behind into a conical excurrent tube; foot strap-shaped.

ARCOPERNA, Conrad, 1865.

Distr.—Eocene; Mississippi, Paris Basin. *A. filosa*, Conrad (cxxix, 20).

Shell oval or oblong, thin, moderately inflated, with terminal, or very nearly terminal, incurved beaks, surface finely or radiately striated, somewhat stronger anteriorly, producing a distinct crenulation at the margin; hinge edentulous, ligament thin, long, situated in a fine marginal furrow of the internal side; muscular scars distinct, the anterior slightly smaller than the posterior, pallial impression simple.

Conrad says that Deshayes' *Mod. radiolata* (Paris foss., 2d ed., vol. ii, p. 22) is congeneric with the above species. Its relation to the short, oval species of *Modiola* is very great, but the well-marked and comparatively large anterior muscular scar, internal ligament, and fine radiating striation may serve as distinction. In general character *Arcoperna* strongly recalls the type of *Phaseolicama*. It is not improbable that the recent *Lith. cinnamominus*, Chemn., is a recent representant of *Arcoperna*, while, on the other hand, cretaceous species, like *Mytilus pileopsis*, d'Orb., and a few others, are equally correctly referable to it, as to *Crenella*, or to any of the allied genera.

MYRINA, H. and A. Adams, 1857.

Distr.—*M. pelagica*, Forbes (cxxx, 21). On floating blubber, off the Cape of Good Hope.

Shell transverse, oblong, subequilateral, close, smooth, covered by a corneous epidermis; nacreous within; beaks submedian; hinge edentulous; ligament internal, linear; anterior muscular impression large.

Animal byssiferous, mantle open.

SUBFAMILY DREISSENSINÆ.

Anterior muscular scar resting on a thickened plate near the apex of the shell, hinge sometimes with an obsolete, long tooth, fulera of ligament strong; pallial line entire, rarely sinuated.

The animal has closed mantle and short siphons, and would therefore go into the order Siphonida, suborder Integripalliata; but the mollusk and its shell are otherwise too closely related to *Mytilus* to admit of such a separation.

DREISSENSIA, Van Beneden, 1836.

Etym.—Dedicated to Dreyssens, a Belgian physician.

Syn.—*Mytilina* and *Mytilomya*, Cantr., 1847. *Congerina*, Partsch, 1836. *Tichogonia*, Rossm., 1835. *Enocephalus*, Munster, 1831.

Distr.—15 sp. Europe, America, Africa. Fossil, 13 sp. Eocene—; Britain, Germany.

Shell like *Mytilus*, without its pearly lining; inner layer composed of large prismatic cells; umbones terminal; valves obtusely keeled; right valve with a slight byssal sinus; anterior

adductor supported on a shelf within the beak; pedal impression single, posterior.

Animal with the mantle closed; byssal orifice small; and siphon very small, conical, plain, branchial prominent, fringed inside; palpi small, triangular; foot-muscles short and thick, close in front of the posterior adductor.

D. polymorpha (cxxxviii, 100; cxxix, 24) is a native of the Aralo-Caspian rivers; in 1824 it was observed by Mr. J. Sowerby in the Surrey docks, to which it appears to have been brought with foreign timber, in the holds of vessels. It has since spread into the canals, docks, and rivers of many parts of England, France and Belgium, and has been noticed in the iron water-pipes of London, incrustated with a ferruginous deposit.

MYTILOPSIS, Conrad, 1857. (Praxis, H. and A. Ad., 1857.) Shell with a lamina on the hinge-shelf or septum. *D. Sallei*, Recluz (cxxix, 22). *D. leucophæata*, Conrad. Brackish waters of Chesapeake Bay, on oysters.

DREISSENUMYA, Fuchs. Septum transformed into a regular, large, anterior muscular scar, pallial line with a deep posterior sinus. *D. Schröckingeri*, Fuchs. Upper Tertiary; Hungary.

SEPTIFER. Recluz, 1848.

Distr.—Warm seas. Fossil; Jurassic and Cretaceous. *S. Heberti*, Desh. (cxxix, 23).

Shell equivalve, very inequilateral; ventral margin subconcave and cut out for the passage of the byssus; beaks subterminal, curved; hinge without teeth, furnished with a lamellar septum; ligamental pits linear, marginal, dorsal, anterior, with a white, nearly spongy margin within; muscular impressions superficial, the anterior small, rounded, the posterior large, subdorsal, uniform.

Animal marine, byssiferous.

MYALINA, Koninck, 1842.

Distr.—Fossil, 6 sp. Silur., Carb.—Permian; Europe. *M. lamellosa*, Koninck (cxxix, 25).

Shell equivalve, mytiliform; beaks nearly terminal, septiferous internally; hinge-margin thickened, flat, with several longitudinal cartilage-grooves; muscular impressions two; pallial line simple. The ligamental area resembles that of *Arca obliquata*, Chemn.

ANTHRACOPTERA, Salter, 1863.

Syn.—Naiadites, Dawson, 1855 (part).

Etym.—*Anthrax*, coal, and *pteron*, a wing.

Distr.—Fossil, 10 sp. Carboniferous; Great Britain, Westphalia, Nova Scotia, United States.

This genus includes several so-called Myalinæ, but they have not the thick hinge-plate of the shells of that genus, and species which have been described by Ludwig as belonging to Dreissensia. The form of the shell is triangular.

HOPLOMYTILUS, Sandberger, 1850.

Distr.—Devonian; Nassau. *H. crassus*, Sandb. (cxxxix, 26).

Shell equivalve, triangular, pyramidal, sides incurved, wider in front, angular behind, beaks contiguous; hinge with an elongated septum under the beak, followed by a longitudinal tooth in the right and a corresponding pit in the left valve.

PACHYMYTILUS, Zittel, 1881.

Distr.—Jurassic. *P. pel'asus*, d'Orb. (cxxxix, 10).

Shell triangular, very thick and massive, with terminal, prominent beaks, and usually smooth surface; anterior to the beak the slope is angularly pinched in, and on the anterior margin, just under the beak, are two fold-like, tubercular teeth; hinge-margin very thick.

SUBFAMILY PRASININÆ.

Shell elongated, very inequilateral, smooth, beaks moderately tumid; hinge with one elongated cardinal tooth in each valve; ligament external, long, supported by thickened fulcra.

In *Modiolopsis* and *Phaseolicama* no hinge-teeth have been observed.

HIPPOPODIUM, Sowb., 1821.

Distr.—Jurassic; Europe. *H. ponderosum*, Sowb.

Shell oblong, thick, ventricose; umbones large; ligament external; ventral margin sinuated; hinge with one thick, oblique tooth in each valve, sometimes nearly obsolete; pallial line simple; anterior muscular scar deep. This shell appears like a ponderous form of *Cypriocardia* or *Cardita*; it is a characteristic fossil of the English Lias, but only very aged examples have been found.

JULIA, Gould, 1862.

Syn.—Prasina, Deshayes, 1863.

Distr.—*J. Borbonica*, Desh. (cxxxviii, 1–3). Isle of Bourbon. *J. exquisita*, Gould. Sandwich Islands.

Shell oblong, thick, cordiform, valves closed, margins entire, inequilateral; lunule deep circular, projecting into the interior of the right valve, left valve in the same place furnished with dentiform tubercles; hinge-line simple, arched; ligament external, narrow; muscular scars two, unequal, subcentral.

Very closely allied to, perhaps not generically distinct from, *Hippopodium*.

MODIOLARCA, Gray, 1840.

Distr.—2 sp. Falkland and Kerguelen Islands, attached by a byssus to floating sea-weed. *M. trapezina*, Lam. (cxxx, 27, 28).

Shell oval, trapezoidal, ventricose, thin, fragile, covered with a thin epidermis; beaks anterior, prominent, contiguous; anterior margin truncate, posterior margin rounded, ventral margin sinuated and slightly gaping; hinge composed of two little teeth in each valve; muscular impressions distinct.

Mantle-lobes united, pedal opening small, foot with an expanded sole, byssiferous, front adductor round.

PHASEOLICAMA, Valenciennes. Hinge without teeth. *M. Magellanica*, Val. (cxxx, 29).

BYSSANODONTA, d'Orb, 1846. Supposed to be related to Anodonta, in the family Unionidæ, but evidently nearly allied to, if not identical with Phaseolicama. It is a minute, perhaps juvenile shell, ten millimetres in length, obrotund, thin, not nacreous, equivalve, brown, hinge without teeth; foot rudimentary; fixed to rocks by a byssus. *B. Paranensis*, d'Orb. (cxxxiv, 93). Near Corrientes, Parana Riv., So. Am.

MODIOLOPSIS, Hall, 1847.

Syn.—Cypriocardites (pt.), Conrad.

Distr.—45 sp. Silur.; N. Am. *M. faba*, Conr. (cxxx, 30).

Shell elongated, very inequilateral, with the beaks anterior, subterminal, and close together, thin, hinge toothless, with the areal margin more or less straight, and a very slight ligamental furrow; ventral margin in front of the middle generally insinuated, the posterior part of the shell being often much wider and higher than the anterior; anterior muscular impression distinct and large.

HIPPOMYA, Salter.

Distr.—Fossil, 1 sp. Devonian.

Shell gibbous, with anterior, inflated close beaks, a long cardinal edge; anterior edge short, rounded, and separated by a strong sinus from the inflated posterior ridge and slope.

MYOCONCHA, J. Sowerby, 1824.

Etym.—*Mya*, mussel; *concha*, shell.

Syn.—Modiolina, Müller.

Distr.—Fossil, 26 sp. Permian—Miocene (d'Orb.); Europe. *M. crassa*, Sowb. (cxxx, 31). *M. angulata*, d'Orb. (cxxx, 32).

Shell oblong, thick, with nearly terminal depressed umbones; ligament external, supported by long, narrow, appressed plates; hinge thick, with an oblique tooth in the right valve; anterior muscular impression round and deep, with a small pedal scar behind it; posterior impression large, single; pallial line simple.

This shell, which is not nacreous inside, is distinguished from any of the Mytilidæ by the form of its ligamental plates and muscular impressions; the hinge-tooth is usually overgrown and nearly obliterated by the hinge-margin, as in aged examples of *Cardita orbicularis* and *Cypricardia vellicata*.

CHÆNOCARDIA, Meek and Worthen, 1869.

Syn.—? *Lunulacardium* (pt.), Münster.

Distr.—*C. ovata*, M. and W. (cxxx, 34). Fossil; Coal-measures, Ills.

Shell equivalve? rather thin, very inequilateral, more or less oval; beaks small, depressed and nearly terminal; valves strongly gaping in front and closed behind; hinge unknown, but short and without cardinal area; surface with concentric striæ, crossed on the posterior dorsal region by faintly marked radiating costæ, and on the gaping front by radiating lines and costæ.

MODIOMORPHA, Hall, 1869.

Distr.—9 sp. Silurian; New York. *M. concentrica*, Conr. (cxxxix, 15).

Shell equivalve, very inequilateral, compressed, subovate; beaks small, compressed, within the anterior third of the length; surface with rugose or undulating concentric striæ, usually coalescing or fasciculating anteriorly; valves crossed obliquely by a more or less distinct sinus, constricting the basal margin; anterior end rounded; hinge with a single strong wedge-shaped tooth in the left valve and a corresponding cavity in the right valve; no lateral teeth; ligament external, attached to the thickened margin of the shell; pallial line entire.

MODIOLINA, Meek, 1877. *M. lata*, Meek. Upper Trias; Buena Vista Cañon, W. Humboldt Range, United States. Not characterized.

PTYCHODESMA, Hall and Whitfield, 1872.

Type, *P. Knappiana*, H. and W. Palæozoic; "Hydraulic Beds," Louisville, Ky.

Shell modioloid in form; valves equally convex; hinge with a wide ligamental area, the sides of which are sharply grooved in parallel lines, caused by the successive growth of the ligament as in *Planorbis*; the grooves and ridges are slightly arched beneath the apex of the valves, where they take their origin; internal hinge-structure unknown.

Resembles *Modiomorpha* in form and surface characters, but differs in having a ligamental area. Externally it is unlike *Cypricardites* and similar shells, which have a ligamental area marked by fine striæ parallel to the hinge-line, while these are parallel to the margin of the shell.

(Aviculacea.)

The following families are often included in Monomyaria :

FAMILY AVICULIDÆ.

Shell inequivalve, very oblique, resting on the smaller (right) valve, and attached by a byssus; epidermis indistinct; outer layer prismatic-cellular, interior nacreous; posterior muscular impression large, subcentral, anterior small, within the umbo; pallial line irregularly dotted; hinge-line straight, elongated; umbones anterior, eared, the posterior ear wing-like; cartilage contained in one or several grooves; hinge edentulous, or obscurely toothed.

Animal with the mantle-lobes free, their margins fringed; foot small, spinning a byssus; gills two on each side, crescent-shaped, entirely free or united to each other posteriorly, and to the mantle (as in the oyster, and not as in Pecten).

The wing-shells, or pearl-oysters, are natives of tropical and temperate seas; there are no living species in northern latitudes, where fossil forms are very numerous. The family is mostly extinct, and largely represented in palæozoic rocks; there are 120 recent and over 1000 fossil species.

SUBFAMILY AVICULINÆ.

Ligament attached to the entire external hinge-margin or placed in a single shallow groove near the beak and spreading over the hinge-area as it extends posteriorly; anterior muscular scar very small.

AVICULA (Klein), Lamarck, 1799.

Etym.—*Avicula*, a little bird.

Syn.—Pteria, Scopoli, 1777. Anonica, Oken, 1815.

Distr.—25 sp. Mexico, South Britain, Mediterranean, India, Pacific; 20 fathoms. Fossil, 300 sp. Lower Silurian—; world-wide. *A. heteroptera*, Lam. (cxxx, 61). *A. crocea*, Lam. (cxxx, 62).

Shell obliquely oval, very inequivalve, eared, the posterior ear produced, wing-like; right valve with a byssal sinus beneath the anterior ear; cartilage-pit single, oblique; hinge with one or two small cardinal teeth, and an elongated posterior tooth, often obsolete; posterior muscular impression (adductor and pedal) large, subcentral; anterior (pedal scar) small, umbonal.

Animal oval, flat; mantle-lobes separated throughout, thickened and serrated at the margins; body very small, having on either side a pair of nearly equal large branchiæ; mouth oval, rather large; palpi large, obliquely truncate; byssus large, coarse, sometimes consolidated.

ELECTROMA, Stolicz. Oblique, thin, mostly smooth; inequivalve, the right valve being somewhat flatter; the hinge-line is short, and the posterior wing very short; not separated from the body of the shell. *A. smaragdina*, Reeve.

PSEUDOPTERA, Meek. Shell more or less obliquely subtrigonal or subovate; hinge short, compressed; anterior wing short, not defined; posterior abbreviated, compressed, and nearly or quite without any marginal sinuosity below it; anterior margins sometimes a little sinuous near the middle, but without any byssal sinus under the anterior wing. *Avicula anomala*, Sby. (cxxx, 38). *Pinna fibrosa*, M. and H. Cretaceous.

OXYTOMA, Meek. Shell with nearly the general outline of the typical form, but usually less oblique, and more inequivalve, with the byssal sinus very deeply and sharply cut, close up under the anterior auricle of the right valve. Several sp. Triassic, Jurassic and Cretaceous. *Avicula Munsteri*, Bronn.

MELEAGRINA, Lam., 1799. (Margaritophora, Muhlfeldt. Perlamater, Schum., 1817.) The "pearl-oysters" are less oblique than the other Aviculæ, and their valves are flatter and nearly equal; the posterior pedal impression is blended with that of the great adductor. Animal with mantle-lobes united at one point by the gills, their margins fringed and furnished with a pendent curtain; curtains fringed in the branchial region, plain behind; foot finger-like, grooved; byssus often solid, cylindrical, with an expanded termination; pedal muscles four, posterior large in front of the adductor; adductor composed of two elements; retractors of the mantle forming a series of dots, and a large spot near the adductor; lips simple; palpi truncated; gills equal, crescentic, united behind the foot. Pearl-oysters are found at Madagascar, Ceylon, Swan River, Panama, etc. Manilla is the chief port to which they are taken. There are three principal kinds, which are worth from £2 to £4 per cwt.: 1. The silver-lipped, from the Society Islands, of which about twenty tons are annually imported to Liverpool. 2. The black-lipped, from Manilla, of which thirty tons were imported in 1851. 3. A smaller sort from Panama, 200 tons of which are annually imported; in 1851 a single vessel brought 340 tons.—T. C. ARCHER. These shells afford the "mother-o'-pearl" used for ornamental purposes; and the "oriental" pearls of commerce. Mr. Hope's pearl, said to be the largest known, measures two inches long, four round, and weighs 1800 grains. Pearl-oysters are found in about 12 fathoms water; the fisheries of the Persian Gulf and Ceylon have been celebrated from the time of Pliny. *M. margaritifera*, Linn. (cxxx, 63).

AUCELLA, Keyserling, 1846. Very inequivalve; left umbo prominent, earless; right valve small and flat, with a deep sinus beneath the small anterior ear. Fossil, 4 sp. Permian—Gault;

Europe. "In *A. cygnipes* we find no trace of prismatic-cellular structure or naere, but the coarsely corrugated and somewhat tubular structure of the Pectens."—CARPENTER. *A. Mosquiensis*, Keyserl. (cxxx, 35).

PTEROPERNA, Morris and Lycett, 1850.

Distr.—Fossil, 3 sp. Bath Oolite; Britain, France. *P. costulata*, M. and L. (cxxx, 39).

Shell with a long posterior wing; hinge-line bordered by a groove; anterior teeth numerous, minute; posterior one or two, long, nearly parallel with the hinge-margin.

An important external character is the presence of a longitudinal ridge on the outside of the wing.

CASSIANELLA, Beyrich, 1861.

Syn.—Gryphorhynchus and Acinophorus, Meek, 1864.

Distr.—Fossil, 6 sp. Upper Trias—L. Lias; Austria, Bavaria, Himalayas. *C. gryphæata*, Münster. (cxxx, 40, 41).

Shell thick, subhemispherical; right valve flat or concave, the left very gibbous; no defined byssal sinus. Umbones subcentral, hinge-line equaling the greatest length of the shell, in both valves with a wide well-defined cardinal area; ears subequal, not produced. Hinge with several small irregular teeth near the middle. Surface striated.

PSEUDOMONOTIS, Beyrich, 1862.

Syn.—Eumicrotis, Meek, 1864.

Distr.—Devon., Triassic, Jurassic. *P. speluncaria*, Münster. (cxxx, 42).

Suborbicular or roundly oval, the right valve being usually more or less convex, with small, or nearly obsolete, wings and prominent incurved beaks; the left is conspicuously flattened or slightly concave; with barely prominent beaks and with a straight, thickened hinge-line, sometimes provided with a flattened tooth-like projection below, and an oblique ligamental groove posterior to it, corresponding to a similar groove or pit in the other valve; the anterior end has below the beak a narrow deep byssal incision and a small, sometimes almost obsolete, ear above it. Posterior adductor large, subcentral, anterior minute, at the base of the wing; surface usually covered with radiating ribs.

PTERINEA, Goldfuss, 1832.

Distr.—Fossil, 32 sp. Lower Silurian—Carb.; United States, Europe, Australia. *P. lævis*, Goldfuss (cxxx, 43).

Shell thick, rather inequivalve, very oblique and broadly winged; beaks anterior, sinus shallow; hinge-area long, straight, narrow, striated lengthwise; anterior teeth few, radiating; pos-

terior teeth laminar, elongated; anterior (pedal) scar deep posterior (adductor) impression large, very excentric.

PTERONITES, M'Coy, 1844. Shell thinner, subtriangular, with the teeth less developed. *P. angustatus*, M'Coy.

EOPTERIA, Billings. (? *Euchasma*, Billings.) Valves equally convex, hinge with an external (?) ligament. *P. typica*, Billings. Lower Silurian; Newfoundland.

ACTINOPTERA, Hall, 1883. Differs from Pterinea in the absence of striated ligamental area, and strong cardinal and lateral teeth; right valve convex. Several sp. Palæozoic; New York. *P. muricata*, Hall.

PTYCHOPTERIA, Hall, 1883. Differs from Actinoptera in the nasute anterior extremity, and large straight wing marked by a strong longitudinal fold. 10 sp. Fossil. Chemung Group; New York. *P. Eugenia*, Hall.

PTERONITELLA, Billings, 1874.

Distr.—3 sp. U. Silurian; Nova Scotia. *P. venusta*, Billings.

Founded on casts showing in front of the beaks several small, anterior cardinal teeth, and close beneath the hinge-line several more or less elongated posterior teeth; there is a strong anterior muscular impression, and the whole structure of the hinge resembles closely that of Cyrtodonta.

HALOBIA, Bronn, 1830.

Distr.—Trias; Hallstadt, Spitzbergen, New Zealand, California, Nevada. *H. rarestriata*, Mojs.

Shell semicircular or semioval, with a straight edentulous hinge-line and almost central, scarcely prominent beaks; valves rather compressed, equal, radiately ribbed, the ribs placed close to the hinge-line being usually conspicuously thicker than others; wings subequal, rounded at their termination and not emarginated, muscular scars indistinct.

The original species described by Bronn is noted as *H. salinarum*, and is based upon an imperfect specimen, apparently restored to a much oblique and inequilateral form. It has the anterior wing conspicuously inflated along the hinge-margin, and hollow internally.

DAONELLA, Mojsisovics, 1874. Lateral margins rounded into the straight dorsal border; cardinal margin compressed or with an oblique furrow on the anterior side, indicating a slight tendency to form an obscure anterior auricle, defined by the faintest possible indication of a marginal sinus. Barely subgenerically distinct. *D. Lommei*, Wissm. (cxxx, 44).

MONOTIS, Bronn, 1830.

Distr.—Trias; Hallein, Himalayas, Thibet, New Zealand, United States. *M. substriata*, Münster. (cxxx, 45).

Shell subequivalve, obliquely oval, depressed, posteriorly slightly eared, anterior side short; surface radiated; beaks depressed, submedian; cardinal line linear, callous, without teeth, with an inflexion for the passage of the byssus.

POSIDONOMYA, Bronn, 1837.

Etym.—*Poseidôn*, Neptune.

Syn.—Posidonia, Br., 1838 (not König). Aulocomya, Steinmann, 1881.

Distr.—Fossil, 50 sp. Lower Silurian—Trias; United States, Europe. *P. Becheri*, Bronn (cxxx, 46).

Shell thin, equivalve, compressed, earless, concentrically furrowed; hinge-line short and straight, edentulous.

RHYNCHOPTERUS, Meek, 1864.

Distr.—*R. obesus*, Meek (cxxx, 47). Triassic; Nevada.

Shell obliquely elongated, tumid, anteriorly narrow, with a small acute ear, posterior side uniformly and slightly curved, not distinctly winged; hinge-line straight, toothless, slightly thickened; surface covered with concentric striae only.

This genus greatly resembles one of the mesozoic Aviculæ with smooth surface, differing from them by the absence of the posterior wing. The shell would also appear to have a close resemblance to Myalina.

MONOPTERIA, Meek and Worthen, 1866.

Distr.—Carboniferous; United States. *M. gibbosa*, M. and W. (cxxx, 48).

Obliquely subquadrate, subequivalve, moderately convex, with a large posterior wing, being below the end generally insinuated, anterior wing obsolete or nearly so, impressed below the beak, without a byssal emargination, but apparently slightly gaping within the lunule; muscular scars very faint; hinge edentulous; ligamental area with a few longitudinal furrows.

This has been proposed as a subgenus of Pterinea, but it appears to have no internal hinge-ribs which characterize that genus. The authors speak of certain ligamental furrows extending internally, but they are not shown in the figure of the cast, which in that part appears perfect.

Meek and Worthen also refer to the relation of Monopteria to Hall's Amphicelia, which, they say, "was proposed as a subgenus under Leptodomus, to which it is not nearly allied. It evidently belongs to the Aviculidæ, near Pterinea, though apparently generically distinct" (see p. 275).

SUBFAMILY AMBONYCHIINÆ.

Shell equivalve, beaks sharp, at the anterior end of the long straight hinge; ligament linear, parallel with the hinge-plate; a

byssal opening anterior to the beaks; anterior wing wanting, posterior wing large.

AMBONYCHIA, Hall, 1843.

Syn.—Pimopsis, Hall, 1843.

Distr.—15 sp. Lower Silurian—Carboniferous; United States, Europe, Australia. *A. bellistriata*, Hall (cxxx, 49).

Roundly subquadrangular, equivalve, moderately inflated, with anterior incurved beaks and a posteriorly extended straight hinge-line, anterior side straight, below the beaks slightly insinuated and gaping, posterior truncate; hinge anteriorly below the beaks with a few short oblique, and posteriorly towards the termination of the hinge-line, also with a few subparallel or slightly diverging rib-like teeth; posterior muscular scar large, subcentral, anterior very small or nearly obsolete.

ANOMALODONTA, Miller, 1873. (Megaptera, M. and W., 1866 [not Gray]. Opisthoptera, Meek.) Subtrigonal, subequivalve, posteriorly with a very large pointed wing, obtusely convexly angular from the beak to the inferior narrow end, beaks anterior, terminal, incurved, slightly projecting above the hinge-line, anterior wing probably obsolete; hinge with a few small anterior teeth below the beak, as in Ambonychia; posterior muscular scar large, subcentral, pallial line extending anteriorly up to very near the beak. This form is considered by its authors to be a subgenus of Ambonychia, differing from it by the very strong development of the posterior wing, on which no internal ribs have as yet been observed. *A. Casei*, M. and W. (cxxx, 50).

AMPHICÆLIA, Hall, 1867.

Distr.—3 sp. Palæozoic; U. S. *A. Leidyi*, Hall (cxxx, 33).

Shell (cast) subrhomboidal, with elevated beaks, beneath which appears a large triangular cartilage-pit, and a second smaller pit anterior to it; no teeth have been discovered on the extension of the hinge-line; muscular impressions faint, shell thin.

LUNULACARDIUM, Münster, 1846 (Zittel, 1881).

Distr.—Devonian; Eur. *L. semistriatum*, Münst.

Shell obliquely oval, like Lima, radially sculptured; with a straight, toothless hinge; posteriorly shortly winged; anteriorly excavated, with a deep lunule and narrow byssal opening.

A portion of the species originally referred to this group, appears similar to, perhaps identical with, Chænocardia, Meek and Worthen.

GOSSELETIA, Barrois, 1881.

Distr.—*G. Devonica*, Barrois. Devonian; Spain.

Shell equivalve, inequilateral, gibbous, oblique, posteriorly

obtusely winged, beaks prominent, turned anteriorly, surface smooth, with growth-lines; the hinge shows a ridge directed posteriorly, on each side of which is the ligamental area, covered with parallel grooves; these grooves are subparallel with the two margins of the shell, but whilst they are regular and straight on the posterior side, they are curved anteriorly; cardinal teeth three, the anterior one usually bifid; pallial impressions unknown.

MYALINADONTA, Ehlert, 1882. Teeth differently disposed, the form is flattened and the cardinal margin is perpendicular to the axis of the shell.

MYTILARCA, Hall, 1869.

Distr.—13 sp. Fossil; Chemung Group, N. Y.; Germany. *M. Chemungensis*, Conr. (cxxx, 51).

Shell equivalve, mytiliform; beaks terminal and hinge-line straight; anterior end of hinge-plate with one to three rather strong oblique teeth in each valve, with corresponding cavities; posterior end with from two to four often obscure, parallel contiguous tooth-like ridges, the marginal one parallel with the posterior border of the valve, the others shorter and divergent; anterior border nearly straight, somewhat sinuate on the margin, apparently for the accommodation of byssal threads; posterior border usually subparallel with the anterior, while the basal margin is generally abruptly rounded like that of *Mytilus*; muscular markings very like *Mytilus*; surface of valves often obscurely radiately striate.

PLETHOMYTILUS, Hall, 1883.

Distr.—Palæozoic; New York. *Inoceramus mytilimerus*, Conrad.

Shell mytiloid, gibbous, with a finely striated ligamental area; hinge edentulous so far as observed. Differs from *Mytilarca* in its erect form, shorter transverse hinge-line, absence of cardinal and lateral teeth, and non-truncate anterior side.

LIMOPTERA, Hall, 1869.

Distr.—5 sp. Fossil. Upper Helderberg and Hamilton Groups; New York, Kentucky. *L. pauperata*, Hall.

Shell large, inequilateral, inequivalve, the right valve smaller; ligamental area large, longitudinally striate, and extending to the extremity of the wings; anterior margins sinuated, forming an elongated byssal opening; hinge edentulous? anterior muscular impression within the umbones, very small and deep; posterior one large, a little behind the middle of the shell, and nearer the hinge than the base; pallial line simple, formed of a series of small, deep pits (or, as seen in the casts, of a series of small nodes).

GLYPTODESMA, Hall, 1883.

Type, *G. erectum*, Conr. Hamilton Group; N. Y.

Ligamental area striated, continuous; hinge with two strong lateral teeth, and numerous irregular transverse plications along the cardinal margin. In form like *Actinodesma*, but without the prominent diverging teeth of that group.

ECTENODESMA, Hall, 1883. Resembles *Glyptodesma* in outline, except that the anterior wing is more produced, and both wings more acute at their extremities; surface ornamented with rays. *G. birostratum*, Hall. Chemung Group; New York.

LEIOPTERIA, Hall, 1883

Distr.—7 sp. Fossil. Hamilton Group; N. Y. *L. Dekayi*, Hall.

Aviculoid, resembling *Actinoptera* in form; anterior extremity auriculate; wing large, extremity produced; surface without prominent rays.

LEPTODESMA, Hall, 1883. In its prevailing forms like *Leiopteria*, except that the anterior end is nasute and acute, instead of auriculate and rounded; hinge-line narrow. 12 sp. Chemung Group; New York. *L. potens*, Hall.

SUBFAMILY PERNINÆ.

Cartilage situated in a number of transverse marginal grooves of the hinge-line. Anterior muscular scar generally very small.

PERNA, Bruguière, 1792.

Etym.—*Perna*, a shell-fish (resembling a gammon). (Pliny.)

Syn.—*Melina*, Retz, 1788. *Isognomon*, Klein, 1753. *Pedalion*, Solander. *Hippochæta*, Sangiovanni.

Distr.—18 sp. Tropical seas; West Indies—India—West America. Fossil, 30 sp. Trias—; United States, Chili, Europe. *P. ephippium*, Linn. (cxxx, 64). *P. Mulleti*, d'Orb. (cxxx, 52).

Shell nearly equivalve, compressed, subquadrate; area wide, cartilage-pits numerous, elongated, close-set; right valve with a byssal sinus; muscular impression double.

The *Pernas* vary in form like the *Aviculæ*; some are very oblique, some very inequivalve, and many fossil species have the posterior side produced and wing-like. In some Tertiary *Pernas* the pearly layer is an inch thick.

PULVINITES, DeFrance, 1824. (*Hypotrema*, d'Orb., 1853.) Shell oblong, inequivalve; right valve flat or concave, with a round byssal foramen near the hinge; left valve convex, with a muscular impression near the umbo; hinge-margin broad, curved, with about twelve close-set transverse cartilage-grooves. *P. Rupellensis* (= ? *Pulvinites Adansonii*, DeFrance, 1826 [cxxx, 53]). Coral-rag, Rochelle.

CRENATULA, Lamarck, 1802.

Syn.—Dalacia, Gray, 1848.

Distr.—8 sp. N. Africa, Red Sea, China—in sponges. Fossil, 4 sp. Jurassic. *C. viridis*, Lam. (cxxx, 65).

Shell thin, oblong, compressed, byssal sinus obsolete; cartilage-pits shallow, crescent-shaped.

? LEPROCONCHA, Giebel, 1856.

A small, roundish shell, with the lamellar structure of an Ostrea, umbones nearly central, as in Brachiopoda, outer surface tubercular, hinge-area with three to four ligamental (?) grooves.

The above name has been proposed for a small Triassic shell which Giebel says comes near to Plicatula or Pulvinites. If the hinge-grooves are ligamental, as they are supposed to be, the classification of this genus would be near Pulvinites; but better material must be examined, in order to define the characters of both these problematic genera.

PERNOSTREA, Munier-Chalmas, 1864.

Distr.—6 sp. Jurassic; Europe. *P. Bachelieri*, M.-C. (cxxx, 54).

Shell rounded or oval, solid, more or less tumid, inequivalve, the left valve being in adult specimens attached; structure lamellar, resembling that of Perna; beaks usually indistinct, hinge-area broad, or with age becomes more or less reduced in extent, with numerous (4–8) transverse ligamental grooves or pits, as in Perna; muscular impression rather small, subcentral, ovately rounded, in the right valve. This genus forms a connecting link between Perna and Ostrea, differing from the former especially by its sessile habitat, absence of a byssal sinus and strongly excavated muscular scar, from the latter by the presence of separate ligamental grooves. Externally Pernostrea is barely distinguishable from Ostrea.

INOCERAMUS, Sowerby, 1814.

Etym.—*Is* (inos), fibre; *keramos*, shell.

Syn.—Mytiloides, Brongt.

Distr.—Fossil, 75 sp. ? Silurian, Trias—Cretaceous; South America, United States, Europe, Algeria, Thibet. *I. concentricus*, Sowb. (cxxx, 55).

Shell inequivalve, ventricose, radiately or concentrically furrowed, umbones prominent; hinge-line straight, elongated; cartilage-pits transverse, numerous, close-set.

This genus differs from Perna chiefly in form. *I. involutus* has the left valve spiral, the right opercular. *I. Cuvieri* attains the length of a yard. Large flat fragments are common both in the chalk and flints, and are often perforated by Cliona.

Hemispherical pearls have been found developed from their inner surface, and spherical pearls of the same prismatic-cellular structure occur detached, in the chalk.—WETHERELL. The Inocerami of the gault are nacreous.

CATILLUS, Brongniart, 1822. (Haploscaplia, Conr.) Shell flattened or ventricose, elongated, cordiform or suborbicular, subequivalve, inequilateral; hinge-line nearly straight, its margin with a short series of small cavities, gradually enlarging; shell fibrous. *I. Lamarckii*, Brongn. (cxxx, 56). Cretaceous.

ACTINOCERAMUS, Meek, 1864. Proposed for a small group of Inocerami of the type of *I. sulcatus*, Park. (cxxx, 57). They have a rather short and sometimes oblique hinge-line, the left valve is often slightly more globose than the right, and both are distinguished from other similar forms by the presence of radiating ribs. The fibrous layer appears to be often thinner in Actinoceramus than in most of the concentrically sulcated Inocerami.

VOLVICERAMUS, Stoliczka. Type, *I. involutus*, Sow. (cxxx, 58), which has the left valve strongly involute like a nautilus or somewhat resembling a Gryphæa, while the right valve is very much smaller, flattened, slightly tumid at the apex, resembling an operculum; the hinge-line is curved, conformed to the ovately rounded aperture of the left valve, thickened and provided with numerous ligamental pits, as in other typical species of the genus.

ANOPÆA, Eichwald, 1861.

Distr.—3 sp. Cretaceous; Russia.

Equivalve, inequilateral, elongated, with the shorter anterior part narrower, beaks close together, with a deep circumscribed lunule in front of them; ligament situated in a number of roundish pits in the straight cardinal margin, which has a rib-like tooth in the left valve below the beak, extending anteriorly for a short distance. Principally differs from Inoceramus by the presence of a deep lunule and by the internal hinge-rib (in the left valve).

GERVILLIA, Defrance.

Etym.—Dedicated to M. Gerville, a French naturalist.

Distr.—Fossil, 37 sp. Carb.—Chalk; Europe. *G. anceps*, Desh. (cxxxii, 90).

Shell like Avicula; elongated; anterior ear small, posterior wing-like; area long and flat, cartilage-pits several, wide apart; hinge-teeth obscure, diverging posteriorly.

BAKEWELLIA, King. Shell small, inequivalve, cartilage-pits 2-5; hinge with anterior and posterior teeth; anterior muscular impression and pallial line distinct. Fossil, 5 sp. Permian; Britain, Germany, Russia, U. S. *G. antiqua*, Münst. (cxxx, 59, 60).

HÖRNESIA, Laube, 1866.

Etym.—Dedicated to Dr. Moritz Hörnes.

Syn.—Goniodus, Dunker.

Obliquely elongated, solid, inequivalve, left valve inflated, with incurved beak, right more or less flattened, hinge-line straight, with a short, narrow, somewhat contorted anterior and a long posterior wing, not separated from the body of the shell, except by a shallow marginal insinuation; ligament situated in several pits externally on the hinge-line, one pit being below the beak and reaching rather internally, one is on the anterior and the remainder on the posterior side; hinge in the left valve consisting of a strong oblique tooth under the beak, separated by a pit from a smaller anterior cardinal; in the right valve there is only one strong tooth, besides that there are generally numerous crenulations at the margin of the hinge-line in both valves, and one or two oblique submarginal ribs posteriorly; muscular scars two, deep, close together, not far from the umbones. Several of the Triassic species of Gervillia, most likely, are referable to this group.

Differs from the typical Gervillia by the peculiar structure of the hinge, and by a more or less lengthened septum going through the cavity of the umbones.

ACTINODESMA, Sandberger, 1856.

Distr.—*A. malleiforme*, Sandb. Devonian; Germany.

Slightly obliquely and broadly oval, moderately convex, with a long, straight hinge-line, produced on either side into a narrow wing, hinge with a number of ribs inclined towards the horizontal hinge-line on either side of the central area on which they are absent; these ribs are separated by grooves in which the ligament is said to be lodged, being almost quite internal.

Stoliczka says: "I do not think that it has been sufficiently established that the grooves alluded to are really ligament or cartilage-grooves. They rather appear to me to be identical with similar hinge-ribs of Pterinea and Gervillia, and the ligament may have been external and marginal, attached to the thickened margin of the shell which slopes internally, as is, for instance, the case in most species of Avicula and particularly in the Meleagrina group."

SUBFAMILY VULSELLINÆ.

Ligament lodged in a special single groove or pit, extending from the beak internally.

VULSELLA, Lam., 1799.

Syn.—Reniella, Swainson, 1840.

Distr.—7 sp. Red Sea, India, Australia, Tasmania. Fossil, 7 sp. Eocene—; Britain, France. *V. rugosa*, Lam. (cxxx, 66).

Shell oblong, striated, subequivalve, with an inner pearly and outer fibrous layer; umbones straight, earless. Often found imbedded in living sponges.

? *VULSELLINA*, Raincourt, 1876. *V. Chaussyensis*, Raine. Fossil; Paris Basin.

MALLEUS, Lam., 1799.

Hammer-oyster. *Syn.*—*Himotopoda*, Schum., 1817.

Distr.—6 sp: China, Australia. None fossil. *M. vulgaris*, Linn. (cxxx, 74).

Shell subequivalve, rugose, dorsal margin long, produced into a narrow wing on each side, median portion long and narrow, waved; hinge with an elongated conical oblique cartilage-pit and no teeth. The young shell is like an ordinary *Avicula*, with a deep byssal notch in the right valve.

DIMYA, Rouault, 1850.

Distr.—Several sp. Eocene to Pliocene; France. One living sp., W. Indies. *D. Deshayesiana*, Rouault (cxxxii, 80, 81).

Shell suborbicular, inequivalve, valves flattened—one of them (the left?) is believed to be adherent—thin; beaks small, subcentral, internally with a small triangular cartilage-pit in each valve; a finely denticulated line issues from the beaks and continues all round near the margin; it was evidently produced by the serrated edge of the mantle; muscular scars two, one anterior and one posterior; the latter is the larger, and both are situated some distance from the margin; pallial line entire.

This is a very peculiar shell; its form and structure resemble *Placenta* or *Placuna*, but there are no hinge-teeth present; the two muscular scars separate the genus from all *Ostreacea*, yet the figure is most like an oyster, and the "second adductor impression," on account of which it is named *Dimya*, is rather like the small anterior scar in *Pecten*.

A living species was recently dredged off the Antilles by the U. S. Coast Survey steamer *Blake*, attached to dead shells. It is practically identical with *Ostrea tenuiplicata*, Seguenza. It is essentially an oyster having two adductor muscles, the exterior layer of the shell pearly, the inner porcellaneous, hinge with a pit like *Hinnites*. Branchiæ consisting of long disunited filaments attached to a cord-like band.

NAYADINA, Munier-Chalmas, 1863.

Distr.—*N. Heberti*, M.-C. (cxxxii, 82–84).

Shell resembling a transverse *Vulsella*, rostrated posteriorly; the internal fibrous layer wanting. Elongately oval, subequivalve, tumid, solid, inequilateral, anteriorly narrowly produced, beaks tumid, obtuse, ligamental pit interior, anteriorly produced, a small tooth in the right valve behind the pit corresponding to

a depression in the other valve; lunular area long, slightly gaping, with simple thickened margins, posterior side shorter, evenly rounded; muscular scar small, subcentral, semilunar, deeply impressed; surface of shell concentrically lamellar.

CHALMASIA, Stoliczka, 1870.

Distr.—Several sp. Cretaceous; Europe. *C. Turonensis*, Duj.

Irregularly oblong, longer than high, with prominent obtuse beaks, subequivalve, the valves being slightly convex, ligamental groove large, moderately excavated, margin in front of the beaks with several irregular incisions, or internal grooves, similar to those of *Eligmus*, muscular scar subcentral, elongated, and strongly thickened.

Munier-Chalmas refers the type species to *Vulsella*, but in no recent or tertiary species of that genus do any incisions or plications occur in front of the beaks, nor is the muscular scar equally strong in any of them. The shell differs from *Eligmus*, merely by its more compressed form and more centrally placed muscular scar and by its thicker shell; it shows greater affinity to *Pedum*, which has, however, only one incision before the beak, and the ligamental pit strongly produced internally.

ELIGMUS, E. Deslongchamps, 1856.

Etym.—*ελγμός*, a sinuosity, in allusion to the sinuosities of the borders of the post-apical opening.

Distr.—3 sp. Inferior Oolite, and Great Oolite; Maine-et-Loire, Calvados, Galicia. *E. polytypus*, Desl. (cxxxii, 85–87).

Shell free, or perhaps attached by a byssus, nearly equivalve, inequilateral; ovate or cylindrical, more or less compressed; anterior extremity inflated, and shorter than the attenuated posterior one. Test rather thick, foliaceous. Umbones inflated, slightly depressed or flattened, diverging and directed backwards. Valves closed at both extremities, with an unsymmetrical (byssal?) sinus behind the umbones; ornamented by oblique, radiating carinated ribs; hinge short, straight, edentulous; ligamental area triangular, with a superficial pit; muscular scar single, situated on the free end of a spoon-shaped process, which originates from beneath the umbonal cavity; pallial line wanting.

The internal process of *Eligmus* has no analogy with that of the *Myæ* and *Anatinæ*, which in them supports the cartilage, and is an internal prolongation of the hinge; whilst that of *Eligmus* gives attachment to the adductor muscle, and arises from beneath the hinge. *Eligmus* is related through *Chalmasia Turonensis*, Dujardin, to *Vulsella*; the test, however, is not fibrous, and M. Munier supposes that the internal nacreous layer has been destroyed by fossilization.

FAMILY PINNIDÆ.

PINNA, Linn, 1758.

Etym.—*Pinna*, a fin or wing.*Distr.*—30 sp. U. S., Britain, Mediterranean, Australia, Pacific, Panama. Fossil, 60 sp. Devonian—. Increasing to the present time. U. S., Europe, South India. *P. rudis*, Linn. (cxxx, 67).

Shell equivalve, wedge-shaped; umbones quite anterior; posterior side truncated and gaping; ligamental groove linear, elongated; hinge edentulous; anterior adductor scar apical, posterior subcentral, large, ill-defined; pedal scar in front of posterior adductor.

Animal with the mantle doubly fringed; foot elongated, grooved, spinning a powerful byssus, attached by large triple muscles to the centre of each valve; adductors both large; palpi elongated; gills long.

The shell of the Pinna attains a length of two feet; when young it is thin, brittle, and translucent, consisting almost entirely of prismatic cell-layers; the pearly lining is thin, divided, and extends less than half-way from the beak. Some fossil Pinnae crumble under the touch into their component fibres. The living species range from extreme low-water to sixty fathoms; they are moored vertically, and often nearly buried in sand, with knife-like edges erect. The byssus has sometimes been mixed with silk, spun, and knitted into gloves, etc.

A little crab which nestles in the mantle and gills of the Pinna was anciently believed to have formed an alliance with the blind shell-fish, and received the name of Pinna-guardian (*Pinnoteris*) from Aristotle; similar species infest the Mussels and *Anomia* of the British coast.

ATRINA, Gray, 1840. Shell irregular, valves connate, as though soldered together on the dorsal margin. *P. saccata*, Linn. (cxxx, 68).

PALEOPINNA, Hall, 1883. Shell gaping in front; surface marked by fine radiating lines. More convex and with finer rays than in Pinna. 2 sp. Palæozoic; N. Y. *P. recurva*, Hall.

TRICHTES, DeFrance, 1828. (*Pinnigena*, Agassiz, 1847.) Shell thick, inequivalve, somewhat irregular, margins undulated. Fossil, 5 sp. Oolitic strata of England and France. *P. undatus*, Lycett (cxxxii, 88). Fragments an inch or more in thickness are common in the Cotteswold-hills; full-grown individuals are supposed to have measured a yard across.

AVICULOPINNA, Meek, 1864. Very elongately subtrigonal, equivalve, with slightly indicated subterminal beaks, the shell being somewhat produced in front of them, posteriorly gaping;

hinge-line very long, edentulous. *Avic. prisca*, Münster (cxxxii, 89), from Permian rocks.

BRYOPHILA, Carpenter, 1864.

Distr.—*B. setosa*, Carp. On algæ, at Cape St. Lucas, L. California.

Shell like a minute Pinna, with pointed beaks; upper margin straight, with a strong internal ligament, anteriorly at the byssal sinus somewhat insinuated, ventrally and posteriorly rounded and gaping; posterior muscular scar subcentral, indistinct.

The animal is stated to be viviparous; and in form "like a minute Pinna, or a transverse Margaritophora without ears, or a Perna without pits." Its length is only 0.13 inch and the width 0.2 inch, but it is said to be adult. The structure of the shell agrees with that of Pinna, being fibrous externally, nacreous internally.

SUBORDER MONOMYARIA.

Shell with a single subcentral or subposterior muscular impression.

(*Pectinacea*.)

FAMILY SPONDYLIDÆ.

Shell inequivalve, right valve largest, attached at the beak; cartilage internal, in a median pit; hinge-teeth two in each valve, sometimes without teeth; outer surface with radiating ribs, often spiniferous.

PLICATULA, Lamarck, 1801.

Etym.—*Plicatus*, plaited.

Distr.—9 sp. W. Indies, India, Philippines, Australia, West America. Fossil, 106 sp. Trias—; United States, Europe, Algeria, India. *P. Mantelli*, Lea, Alabama, has the valves eared. *P. ramosa*, Linn. (cxxxii, 69).

Shell irregular, attached by the umbo of the right valve; valves smooth or plaited; hinge-area obscure; cartilage quite internal; hinge-teeth two in each valve; adductor scar simple.

Animal resembles Spondylus.

HARPAX (Parkinson, 1811), Deslongchamps, 1858. Hinge of attached valve consisting of a flattened triangular plate, traversed by a central more or less perpendicular ligamental furrow, exterior to which are slightly marked diverging sulci to receive the elevated borders of the ligamental groove in the other valve; the outer borders of the plate form lengthened and elevated dental processes. Hinge-plate of free valve traversed mesially by the ligamental groove, the borders to which are elevated and but slightly diverging; exterior to these are

strongly impressed grooves to receive the dental processes of the other valve. Fossil, 16 sp. Lias and Lower Oolite; France and England.

SPONDYLUS (Pliny), Linn.

Thorny-oyster.

Syn.—Dianchora, Sby., 1814. Podopsis, Lam., 1819. Pachytes, Depr., 1825. (All based upon casts or imperfect specimens.—DESHAYES.)

Distr.—68 sp. West Indies, Canaries, Mediterranean, India, Torres Straits, Pacific, West America; 105 fathoms. Fossil, 80 sp. Carb—; Europe, United States, India. *S. regius*, Linn. (cxxx, 71, 73). *S. Americanus*, Lam. (cxxx, 72).

Shell irregular, attached by the right valve, radiately ribbed, spiny or foliaceous; umbones remote, eared; lower valve with a triangular hinge-area, cartilage in a central groove, nearly or quite covered; hinge of two curved interlocking teeth in each valve; adductor impression double.

Animal with the mantle open and gills separate, as in Pecten; lips foliaceous, palpi short; foot small, cylindrical, truncated.

In aged specimens the circular portion of the muscular scar exhibits dendritic vascular markings. The lower valve is always most spiny and least colored; in some species (like *S. imperialis*) the shell is scarcely, if at all, attached by its beak or spines. The inner shell-layer is very distinct from the outer, and always wanting in fossil specimens from calcareous rocks, then called Dianchoræ. Specimens from the Miocene of St. Domingo, which have lost this layer, contain a loose mould of the original interior. Water-cavities are common in the inner layer, the border of the mantle having deposited shell more rapidly than the umbonal portion.

PEDUM, Brug., 1792.

Distr.—Red Sea, Indian Ocean, Mauritius, Chinese Seas. *P. Spondyloideum*, Gmel. (cxxx, 70).

Shell thin, smooth, compressed, attached by a byssus passing through a deep notch in the right valve. Inhabits coral-reefs, where it is found half-embedded.

TERQUEMIA, Tate, 1867.

Ety.—Dedicated to M. O. Terquem, an eminent palæontologist.

Syn.—Carpenteria, E. Deslongchamps, 1858 (*non* Gray, 1856).

Distr.—Fossil, 5 sp. Trias—Lias; France, Germany, Great Britain. *T. Heberti*, Terquem.

Shell inequivalve, subequilateral, attached by the umbonal portion of the right valve; the left valve slightly concave,

smooth, and ornamented posteriorly, as also the free portion of the right valve, by concentric plications or radiating ribs. Hinge-area triangular, transverse, striated in the same direction, edentulous, sometimes produced in the middle line; ligamental furrow median, longitudinal, straight, rather narrow. Muscular scar near the posterior margin; pallial line wanting. Externally the shells of this genus resemble those of Hinnites and Ostrea.

FAMILY LIMIDÆ.

Shell eared, white, gaping at the sides; hinge edentulous, with a central, triangular cartilage-pit.

The large development of the internal thin layer of the mantle, forming an open bag, appears to be destined for hatching the eggs, and is no doubt also an important organ for retaining water while swimming.

Mostly extinct, from palæozoic. Nearly 300 fossil species, but few of them in the new world.

LIMA, Bruguière, 1792.

Etym.—*Lima*, a file. *Syn.*—*Radula*, Klein.

Distr.—20 sp. Norway, Britain, W. Indies, Canaries, India, Australia; 1–150 fms. The largest living species (*L. excavata*, Chemn.) is found on the coast of Norway. Fossil, 300 sp. Carb., Trias—; United States, Europe, India. *L. squamosa*, Lam. (cxxxii, 91. 92).

Shell equivalve, compressed, obliquely oval; anterior side straight, gaping, posterior rounded, usually close; umbones apart, eared; valves white, smooth, punctate-striate, or radiately ribbed and imbricated; there is usually a thin, brownish epidermis; hinge-area triangular, cartilage-pit central; adductor impression lateral, large, double; pedal scars two, small.

Animal: mantle-margins separate, inner pendent, fringed with long tentacular filaments, ocelli inconspicuous; foot finger-like, grooved; lips with tentacular filaments, palpi small, striated inside; gills equal on each side, distinct.

The shell is always white; its outer layer consists of coarsely plicated membranous lamellæ; the inner layer is perforated by minute tubuli, forming a complete network.—CARPENTER.

“The Lima moves or rather darts through the water like a scallop, but in a contrary posture. The hinder instead of the ventral end is in front, so that the mode of its progression may be compared to that of a fish swimming tail foremost. Some species construct dwelling-places called ‘nests’ out of fragments of shell, nullipores, gravel and other material, which they ingeniously fasten together by their byssal threads and attach to the roots of large sea-weeds. Several young ones often occupy

the same nest or case; but when they become adult each individual has a house of its own. This remarkable construction is funnel-shaped, with the larger end contracted, and sufficiently wide to admit of the Lima moving freely up and down, but not turning around in it. Here it lives, secure from prowling fish and crabs. The case is lined inside with a closely-woven net of byssal threads, plastered over with slime or excrement. This smooth and soft lining contains a quantity of Diatom-cells, and yields a rich harvest to those who collect these exquisite organisms for microscopic examination. When the Lima is first taken out of its case and put into a basin of sea-water, it is exceedingly active and restless, or else gracefully careering about, with its long and thick fringe of filaments trailing behind it. In the course of a few minutes it seems to get tired or reconciled to its prison; and it then lies on its back, the valves of the shell expanded, and reposes on its own soft, luxurious cushion. The filaments at first curl and entwine round one another, a perfect nest of snakes, but afterwards they are withdrawn and become contracted, a circular inner row, like a coronet, surrounds the slowly flapping gills; and the outer rows fold over on each side and form a sort of chevaux de frise. Dr. Landsborough supposed that these filaments were useful to the Lima in catching its prey. He observed that they were very easily broken off, and that they seemed to live many hours after being detached from the body, wriggling about like so many worms. A remarkable peculiarity of Lima consists in the tenacious grasp of its tentacles; sometimes when my finger touched the animal, it was rapidly seized by the tentacles, as by those of an Actinia, and so firmly that I have dragged the Lima round the tank. It seldom let go its hold till the tentacles were torn away, or (as I believe) voluntarily thrown off by the animal. The tentacles so detached still adhere closely to the object they have grasped, their free ends twisting about as if conscious of life, and they are with difficulty taken off."—Dr. J. GWYN JEFFREYS, *Brit. Conch.*

LIMATULA, S. Wood, 1839. Valves equilateral, radial ribs only developed in the middle of the shell. 8 sp. Greenland—Britain. Fossil. Miocene—; Europe. *L. bullata*, Born (cxxxii, 93).

LIMÆA, Bronn, 1831. Hinge minutely toothed. *L. strigillata*, Brocchi. Fossil, 4 sp. Lias—Pliocene. The recent *Limæa*? *Sarsii*, Lovén (cxxxii, 94), Norway (= *L. crassa* of the Ægean?), has the mantle-border plain. Some of the larger recent species have obscure lateral teeth.

CTENOIDES, Klein, 1753. Shell thin, subequilateral; sculpture radiating from the longitudinal centre-line of the valve. *L. scabra*, Born (cxxxii, 95).

MANTELLUM, Bolten, 1798. Shell thin, ventricose, oblique,

strongly gaping anteriorly; cardinal line oblique. *L. inflata*, Chemn. (cxxxii, 96).

ACESTA, H. and A. Adams, 1855. Shell thin, inequilateral, ventricose, a little gaping; surface covered by radiating striæ, and concentric growth-lines; ligament-pit oblong, lateral. *L. excavata*, Chemn. (cxxxii, 97).

PLAGIOSTOMA, Sow., 1812. Must be reserved for the species of the type of the Liassic *Pl. gigantea*, for which it was originally proposed. It is a very well-marked group of fossil, especially mesozoic, Limæ, of a semioval or subtriangular shape, with nearly smooth or finely radiately striated surface, the striæ being generally only conspicuous at the sides of the valves, but nearly obsolete in the middle; the ears are thick and unequal, the anterior being smaller, and the cartilage-pit is oblique and triangular, generally very deep. *L. Cardiformis*, Sowb. (cxxxii, 98).

CENOSTREON, Eichw., 1867. Subequivalve, with strong radiating ribs, the large anterior margin above, or at the side with a distinct byssal sinus. *Ct. distans*, Eichw. Neocomian of Russia. This is another well-marked group of generally large and strongly ribbed Limæ, the shell of which is often irregular, like that of some Hinnites; when adult, it is characterized by the presence of a deep insinuation in the anterior ear for the byssus, but in young shells this insinuation is hardly more developed than in other allied forms. *Lima proboscidea* of Sowerby, from Jurassic deposits, is another species of the subgenus, and there are a few other mesozoic forms which may be referred to it.

FAMILY PECTINIDÆ.

Shell free or adherent, inequivalve, regular or irregular, auricled; internal ligament inserted in a cardinal pit under the beaks—it is sometimes externally prolonged, in the adherent species, in a notch between the beaks.

No siphons; foot small and cylindrical; mantle open, its lobes tentaculated.

PECTEN, O. F. Müller.

Etym.—*Pecten*, a comb. Scallop.

Syn.—Argus, Poli. Discites, Schl. Amussium, Muhlfeldt.

Distr.—200 sp. World-wide; Nova-Zembla—Cape Horn; 200 fathoms. Fossil, 450 sp. (including Aviculopecten). World-wide; Devonian—. *P. purpuratus*, Lam. (cxxxiii, 14). *P. pallium*, Linn. (cxxxiii, 13).

Shell suborbicular, regular, resting on the right valve, usually ornamented with radiating ribs; beaks approximate, eared; anterior ears most prominent; posterior side a little oblique; right valve most convex, with a notch below the front ear; hinge-

margins straight, united by a narrow ligament; cartilage internal, in a central pit; adductor impression double, obscure; pedal impression only in the left valve, or obsolete.

Animal with the mantle quite open, its margins double, the inner pendent like a curtain, finely fringed; at its base a row of conspicuous round black eyes (ocelli) surrounded by tentacular filaments; gills exceedingly delicate, crescent-shaped, quite disconnected posteriorly, having separate excurrent canals; lips foliaceous; palpi truncated, plain outside, striated within; foot finger-like, grooved, byssiferous in the young.

The scallop (*P. maximus*) and "quin" (*P. opercularis*) are, in Europe, esteemed delicacies; the latter covers extensive banks, especially on the north and west of Ireland, in 15–25 fathoms water. The scallop ranges from 3–40 fathoms; its body is bright orange, or scarlet, the mantle fawn-color, marbled with brown; the shell is used for "scalloping" oysters; formerly it was employed as a drinking cup, and celebrated as such in Ossian's "hall of shells." An allied species has received the name of "St. James's shell" (*P. Jacobæus*); it was worn by pilgrims to the Holy Land, and became the badge of several orders of knighthood.

Most of the *Pecten* spin a byssus when young, and some, like *P. varius*, do so habitually; *P. niveus* moors itself to the fronds of the tangle (*Laminaria*).

The Rev. D. Landsborough observed the fry of *P. opercularis*, when less than the size of a sixpence, swimming in a pool of sea water left by the ebbing of the tide. "Their motion was rapid and zigzag; they seemed, by the sudden opening and closing of their valves, to have the power of darting like an arrow through the water. One jerk carried them some yards, and then by another sudden jerk they were off in a moment on a different tack." European epicures regard the large species as dainty articles of food, and the American *P. irradians*, of late years, is increasingly sold in our markets.

The shell of *Pecten* and the succeeding genera consists almost exclusively of membranous laminae, coarsely or finely corrugated. It is composed of two very distinct layers, differing in color (and also in texture and destructibility), but having essentially the same structure. Traces of cellularity are sometimes discoverable on the external surface; *P. nobilis* has a distinct prismatic-cellular layer externally.—CARPENTER.

PALLIUM, Schum., 1817. (*Dentipecten*, Ruppell, 1835. *Decadopen*, Sowb., 1839) Hinge obscurely toothed. *P. plica*, Linn. (cxxxiii, 15).

CHLAMYS, Bolten, 1798. (*Argus*, *Argoderma*, Poli.) Shell subequivalve, with radiating striæ or ribs. *P. islandicus*, Chemn. (cxxxiii, 16).

LYROPECTEN, Con., 1867. (*Lyropecten*, Conrad.) Somewhat inequivalve, with moderately developed unequal ears, valves ornamented with strong nodulose and striated ribs, near the umbones always somewhat irregularly gibbose; hinge with a few oblique teeth on each side of the ligamental fosset. Type, *P. nodosus*, Linn. (cxxxiii, 17). There are a few tertiary species from North America referred to this subgenus, and it is very likely also that species, like the cretaceous *P. septemplicatus*, Nilss., and a few others, belong to it.

CAMPTONECTES, Agassiz, 1864. (*Eburneopecten*, Agass., 1865.) Valves subequal, moderately flattened, ovate or subovate, with well-developed, or rather small, unequal ears, the anterior of the right valve with a byssal sinus, surface marked with fine radiating, curved striæ, separated by punctated grooves. Type, *P. lens*, Sow. Forms belonging to this subgenus only occur in the mesozoic strata. The two valves often are unequally strongly striated.

PSEUDAMUSSIUM, Klein, 1753. (*Syncyclonema*, Meek, 1864.) Shell fan-shaped, thin, subequivalve; smooth, or striate, or with a few large, rounded ribs. *P. pseudamussium*, Lam. (cxxxiii, 18).

PLEURONECTIA, Swainson, 1840. (*Amussium*, Klein, 1753.) Shell nearly orbicular, depressed, subequivalve, with very small ears; smooth outside, with radiating ribs inside. Large species, with the peculiarity that one valve is highly colored, the other white. The group is almost sufficiently distinct from *Pecten* to merit the generic position given it by several systematists. *P. Japonicus*, Gmel. (cxxxiii, 19).

PSEUDOPECTEN, Bayle, 1879. Lias; Europe. *P. æquivalvis*, Lam.

VOLA, Klein, 1753. (*Janira*, Schum., 1817.) Lower valve convex, with produced large beaks, upper valve plane or slightly concave, and frequently smaller than the lower one. *P. dentatus*, Sowb. (cxxxiii, 20). *P. atavus*, d'Orb. (cxxxii, 99).

NEITHEA, Drouet, 1824. Shell inequivalve, like *Vola*, but with obscure cardinal teeth on the sides of the cartilage-pit, and tooth-like folds on the wings. Fossil only. *P. æquicostatus*, Lam. (cxxxii, 100, 1).

HEMIPECTEN, Adams and Reeves, 1848.

Distr.—1 sp. Sooloo Archipelago. Fossil; Jurassic. *H. Forbesianus*, A. and R. (cxxxiii, 21).

Shell inequivalve, irregular, more or less transparent; upper valve auricled, with a slit below the ear, with denticulated margin; hinge toothless; ligament marginal, in a small central pit.

H. Forbesianus, Ad. and Reeve, is the only recent species known. It appears to adhere temporarily by the right flattened valve to submarine objects; its thin hyaline structure is

very characteristic, and so is also the small marginal cartilage-pit.

HINNITES, DeFrance, 1821.

Distr.—4 sp. Europe, California, etc. Fossil; Triassic—. *H. sinuosus*, Lam. (cxxxiii, 22, 23).

Shell oval, irregular, inequivalve, subequilateral, close, adhering by the right valve; eared irregularly; hinge without teeth; ligament thick, in a deep, narrow pit.

Differs from *Pecten* in its irregular growth, and in being adherent.

AVICULOPECTEN, M'Coy, 1852.

Syn.—? *Aphania*, de Koninck.

Distr.—Fossil. Devonian—Carb.; Spitzbergen—Australia, N. America. *A. granosus*, Sowb. (cxxxii, 5).

Shell inequivalve, suborbicular, eared; hinge-areas flat, with several long, narrow cartilage-furrows, slightly oblique on each side of the umbones; right valve with a deep and narrow byssal sinus beneath the anterior ear; adductor impression large, simple, subcentral; pedal scar small and deep, beneath the umbo.

Aviculopecten does not possess the prismatic structure of the *Aviculidæ*, but the peculiar corrugated tubular structure of the *Pectinidæ* (Meek). It bears the same relations to existing *Pectens* as *Pterinea* does to existing *Aviculas*.

PTERINOPECTEN, Hall, 1883. Hinge-line long; wings not well-defined, being simple expansions or extensions of the upper lateral margins to the hinge-line. 5 sp. Hamilton and Chemung Groups; New York. *A. undosus*, Hall.

EUCHONDRIA, Meek, 1874. Uncharacterized. Type, *Aviculopecten neglectus*, M. and W. (cxxxii, 7, 8). Carboniferous; Ills.

LYRIOPECTEN, Hall, 1883. Differs from *Aviculopecten* in the short hinge-line and very small anterior wing; surface usually ornamented with strong rays. 5 sp. Chemung and Hamilton Groups; New York. *A. magnificus*, Hall.

PERNOPECTEN, Winchell, 1865.

Etym.—*Perna* and *Pecten*, from a combination of some of the characters of the two genera. *Syn.*—*Entolium*, Meek, 1865.

Distr.—Fossil, 7 sp. Carboniferous; Michigan, Belgium, Nassau. *P. glaber*, Hall (cxxxii, 6). Probably others referred to *Avicula*, *Pterinea*, and more especially to *Aviculopecten*, *Amussium* and *Pecten*.

Shell subequivalve, inequilateral, auriculated; hinge-line straight, with a central triangular cartilage-pit and a transverse plate, with smaller lateral cartilage-pits diminishing in size and depth from the centre outwards.

Pernopecten agrees with *Amussium* in its subsymmetrical ears, cardinal cartilage-pit, and in the absence of radiating ridges, but differs in its straight hinge-line and lateral cartilage-pits. *Entolium*, Meek, is founded on a Jurassic species from California, *P. aurarium*, Meek.

CRENIPECTEN, Hall, 1883. Like *Aviculopecten* in form; hinge furnished with a series of small cartilage-pits throughout its entire length. 12 sp. Chemung Group; N. Y. *P. Leon*, Hall.

STREBLOPTERIA, M'Coy, 1851.

Distr.—Carboniferous. *S. lævigata*, M'Coy (exxxii, 9).

Shell ovate or rounded, obliquely extended towards the anterior side; posterior wing broad, undefined, nearly rectangular, extending nearly as far as the posterior margin of the shell; anterior ear small, deeply defined; surface smooth or radiatingly ridged; one large, faintly marked muscular impression a little behind the middle; one short, narrow tooth, slightly diverging from the hinge-line, on the posterior side of the beaks; ligament confined to a narrow, simple facet on the hinge-margin.

These shells differ from the short-winged *Aviculæ*, to which they are most allied, by the obliquity of the body of the shell being towards the anterior instead of the posterior side.

(*Anomiacea.*)

FAMILY ANOMIIDÆ.

Shell thin, perlaceous, with a deep notch or hole in the inferior valve near the beaks, for the passage of a byssal plug, by which the shell is attached.

Mouth with narrow, plain lips, confluent with the gills, palps obsolete; mantle quite open, except at the hinge, with a double pendent margin, fringed with short cirri; no ocelli; gills two on each side, unsymmetrical, united posteriorly, and suspended by two falciform membranes; outer gill-lamina furnished with a broad reflexed margin; foot small, cylindrical, expanded at the end and grooved. Sexes distinct. Byssus large, laminar, passing through a nearly complete foramen in the right mantle-lobe, and attached by a powerful muscle to the centre of the left valve. The *Anomia ephippium* is used in France as an article of food.

ANOMIA, Linn., 1767.

Etym.—*Anomios*, unequal.

Syn.—*Fenestrella*, Bolten. *Cepa*, Humph.

Distr.—20 sp. North America, Britain, Black Sea, India, Australia, West America, Icy Sea. Low-water—100 fathoms. Fossil, 36 sp. Oolite—; Chili, United States, Europe, India. *A. ephippium*, Linn. (exxxiii, 24).

Shell suborbicular, very variable, translucent, and slightly pearly within, attached by a plug passing through a hole or notch in the right valve; upper valve convex, smooth, lamellar or striated; interior with a submarginal cartilage-pit, and four muscular impressions, three subcentral, and one in front of the cartilage; lower valve concave, with a deep, rounded notch in front of the cartilage-process; disk with a single (adductor) impression.

Animal with the mantle open, its margins with a short double fringe; lips membranous, elongated; palpi fixed, striated on both sides; gills two on each side, united posteriorly, the outer laminae incomplete and free; foot small, cylindrical, subsidiary to a lamellar and more or less calcified byssal plug, attached to the upper valve by three muscles; adductor muscle behind the byssal muscles, small, composed of two elements; sexes distinct; ovary extending into the substance of the lower mantle-lobe.

"There is no relationship of affinity between *Anomia* and *Terebratula*, but only a resemblance through formal analogy; the parts which seem identical are not homologous."—FORBES.

The *Anomiæ* are found attached to oysters and other shells, and frequently acquire the form of the surfaces with which their growing margins are in contact.

PATRO, Gray, 1849. Shell suborbicular; two upper scars small, the lower one large. *A. elyros*, Gray (cxxxiii, 25).

ÆNIGMA, Koch, 1845. Shell oblong, transverse. *Æ. ænigmatica*, Chemn. (cxxx, 75). Lives attached to trees in mangrove-swamps.

LIMANOMIA (*Grayana*), Bouchard. Fossil, 4 sp. Devonian; Boulogne. Inequivalve, valves thin near the beaks, slightly radially ribbed; lower valve with a trigonal cut under the ear and near the beak.

PLACUNOPSIS, Morr. and Lycett, 1853. Suborbicular, generally somewhat irregular, inequivalve; larger valve convex, with small submarginal, submedian beak, and mostly ornamented with radiating ribs or striæ; smaller valve flat, free, or attached to foreign objects; hinge toothless, with a small cartilage-pit in each valve; muscular scar large, subelliptical, subcentral. Type, *P. Jurensis*, Roem. All the species as yet known are from Jurassic deposits, but it is not certain whether all the Jurassic species referred to *Placunopsis* agree with the characteristics above noticed; many of them appear to belong to *Anomia* (typical), and doubts are expressed on this point even regarding the type species, *P. Jurensis*.

PLACUNANOMIA, Broderip, 1832.

Distr.—13 sp. West Indies, Britain, New Zealand, California,

Behring's Sea, Ochotsk; 50 fathoms. Miocene; California. *P. macrochisma*, Desh. (cxxxix 76).

Shell adherent, subequivalve, irregular, flattened; hinge with two thick, divergent elongated lamella in the inferior, corresponding with two long pits in the upper valve; upper valve with only two muscular impressions; the pedal scar radiately striated; the byssal plug is often fixed in the lower valve, and its muscle becomes (functionally) an adductor.

PODODESMUS, Philippi, 1849. Valves radiately grooved; perforation of lower valve moderate, firmly embracing and enclosing the plug. *P. rudis*, Brod. (cxxxix, 77).

MONIA, Gray, 1849. Valves radiately grooved; perforation of lower valve large, only slightly embracing the large, thin, plug. *P. Zealandica*, Gray (cxxxix, 26).

PARANOMIA, Conrad, 1860. Irregular, inequivalve, one valve flattened or slightly concave, hinge of lower valve with a broad, irregular, triangular tooth or plate, flattened or slightly convex, with sharp margins and an anterior, compressed, small, but prominent tooth; muscular impression situated toward the ventral margin in a line with the apex, or nearly equidistant from the anterior and posterior ends. Type, *Placunanomia Saffordi*, Con., from cretaceous rocks of Tennessee. There are only two other cretaceous species which Conrad refers to the same group; it seems to be closely allied to Philippi's Pododesmus. The convex valve has no teeth or appendage, and is generally radiately ribbed; the flatter valve is often attached near the umbo to other objects and very thin, but not perforated.

CYCLOSTREON, Eichwald, 1867.

Distr.—Fossil. Cret., Eocene; Europe.

Shell obliquely ovate, with attenuated obtuse beaks, inequivalve; one (right?) valve convex; the other (left?) smaller, flat or concave, with a small transverse ligamental groove at the apex; in the convex valve there is only a small lateral groove below the beak, placed somewhat anteriorly; both beaks are truncate and appear to indicate an attachment to foreign bodies; muscular impression indistinct, represented by a marginal zone which surrounds the cavity of the convex valve. The type greatly resembles Hemiplicatula, but is stated to have no such hinge or cartilage ribs as are characteristic of that genus.

ANOMIANELLA, Ryckholt, 1852.

Distr.—*A. proteus*, Ryck. (cxxxix, 12). Carboniferous; Belgium.

Shell ovate, thin, found attached to other shells; there appears to be no perforation in the lower valve.

DIPLOSCHIZA, Conrad, 1866.

Distr.—*D. cretacea*, Conr. (cxxxiii, 27, 28). Cret.; Ala.

Subovate, inequivalve, smaller valve concave, both of a laminated structure and with truncate, deeply notched or emarginated beaks.

Conrad says that "the shell seems to have been attached by the umbo of the larger valve, the truncature of which reminds us of the truncated beak of *Terebratula*." It is a curious shell and indicates great similarity to a brachiopod form.

OSTRENOMIA, Conrad, 1872.

Distr.—*O. Carolinensis*, Conr. (cxxxiii, 29, 30). Eocene; N. Carolina.

Shell inequivalve, irregular, laminated; hinge with a triangular cartilage-pit; right valve with a deep notch or sinus having an internal raised margin; left valve with an angular dentiform process at the base of the cartilage-pit.

CAROLIA, Cantraine, 1835.

Dedicated to Prince Charles Bonaparte.

Syn.—*Hemiplacuna*, G. Sowerby.

Distr.—3 sp. Tertiary; Egypt. *C. placunoides*, Cantr. (cxxxii, 2).

Shell like *Placuna*; hinge, when young, like *Anomia*, with a byssal plug passing through a small deep sinus in front of the cartilage-process, which is closed in the adult.

FAMILY PLACUNIDÆ.

Shell equivalve or nearly so, compressed, thin, pearly, externally often finely lamellar; ligament marginal, cartilage attached to the external side of two diverging ribs in one valve, corresponding to two similar grooves or ribs in the other valve.

Free, without byssus, found on sandy shores.

PLACUNA, Solander.

Etym.—*Plakous*, a thin cake. Window-shell.

Distr.—4 sp. Scinde, North Australia, China. *P. orbicularis*, Retz. (cxxxiii, 31).

Shell suborbicular, compressed, translucent, free, resting on the right valve; hinge-area narrow and obscure; cartilage supported by two diverging ridges in the right valve and corresponding grooves in the left; muscular impressions double, the larger element round and central, the smaller distinct and crescent-shaped, in front of it.

The *Placunæ* are very closely allied to *Anomia*; and many intermediate forms may be traced. The shell of each consists

entirely of subnacreous, plicated laminæ, peculiarly separable, and occasionally penetrated by minute tubuli.—CARPENTER.

P. sella, called from its shape the "saddle-oyster," is remarkably striated.

Placuna is essentially like Anomia, having the generative system attached to the right mantle-lobe, and the ventricle exposed. The mantle-margin is cirrated, and furnished with a curtain, as in Pecten; the foot is tubular and extensile, the small muscular impressions before and in the rear of the adductor are produced by suspensors of the gills.

PLACENTA, Auct. (Not Retzius, 1788 = Placuna. Placunema, Stoliczka, 1870.) Shell thin, suborbicular, semitransparent; cartilage-grooves and lamellæ slightly divergent, the posterior longest; muscular impression subcentral. *P. sella*, Gmel. (cxxxix, 78). China.

PSEUDOPACUNA, Mayer, 1876. Shell lenticular, rather thick, almost smooth and nearly equivalve; upper valve swollen; muscular impression large, round, central, approaching the hinge; hinge-lamellæ strongly diverging, dissimilar. *P. Helvetica*, Mayer. Eocene; Eur.

SAINTIA, Raincourt, 1877. Shell small, rounded, smooth; muscular impression large, approaching the posterior margin; hinge with two diverging lamellæ enclosing a third very small tooth. *S. Munieri*, Raincourt (cxxxii, 10, 11). Fossil; Paris Basin.

HEMIPICATULA, Desh., 1864.

Distr.—*H. solida*, Desh. (cxxxiii, 32, 33). Fossil; Paris Basin.

Shell roundly oval, solid, compressed, subequivalve, hinge with two slightly diverging hinge-ribs in each valve, those of the right valve fitting between those of the left, which are less elevated and have between them a small fosset; the cartilage is attached, as in Placuna, along the external sides of the hinge-ribs, and this forms the principal distinction between the present genus and Plicatula, where the cartilage is situated in the median pit.

? BICORIUM, Meyer, 1880. *B. irregulare*, Meyer. Oligocene; Germany.

(*Ostracea*.)

FAMILY OSTREIDÆ.

Shell inequivalve, slightly inequilateral, free or adherent, resting on one valve; beaks central, straight; ligament internal; epidermis thin; adductor impression single, behind the centre; pallial line obscure; hinge usually edentulous.

Animal marine; mantle quite open; very slightly adherent

to the edge of the shell; foot small and byssiferous, or obsolete; gills crescent-shaped, two on each side; adductor muscle composed of two elements, but representing only the posterior shell-muscle of other bivalves.

The union of the Ostreidæ and Pectinidæ, as proposed by the authors of the "History of British Mollusca," has not proved satisfactory. The genus *Ostrea* stands quite alone, and distinct from all the Pectinidæ in the structure of its gills, which are like those of *Avicula*, and by resting on its left valve. The shell also is more nacreous than that of the scallops.

OSTREA, Linn.

Syn.—*Peloris*, Poli.

Distr.—70 sp. Tropical and temperate seas. Norway, Black Sea, etc. Fossil, 200 sp. Carb.—; United States, Europe, India. *O. Virginica*, Linn. (vol. i, t. 22; cxxxiii, 34).

Shell irregular, attached by the left valve; upper valve flat or concave, often plain; lower convex, often plaited or foliaceous, and with a prominent beak; ligamental cavity triangular or elongated; hinge toothless; structure subnacreous, laminated, with prismatic-cellular substance between the margins of the laminae.

Animal with the mantle-margin double, finely fringed; gills nearly equal, united posteriorly to each other and the mantle-lobes, forming a complete branchial chamber; lips plain; palpi triangular, attached; sexes distinct.

The interior of recent oyster-shells has a slightly nacreous lustre; in fossil specimens an irregular cellular structure is often very apparent on decomposed or fractured surfaces. Fossil oysters which have grown upon *Ammonites*, *Trigonia*, etc., frequently take the form of those shells.

In the "cock's-comb" oysters both valves are plaited; *O. diluviana* sends out long root-like processes from its lower valve. The "tree-oyster" (*Dendrostrea*, Sw.) grows on the root of the mangrove. Oyster-shells become very thick with age, especially in rough water; the fossil oyster of the *Tagus* (*O. longirostris*) attains a length of two feet; *O. Taliénwanensis*, Crosse, grows to the length of three feet in the Bay of Taichou, Japan. The greatest enemy of oyster-banks is a sponge, which eats into the valves, both of dead and living shells; at first only small round holes, at irregular intervals, and often disposed in regular patterns, are visible; but ultimately the shell is completely mined and falls to pieces.

EXOGYRA, Say. (*Amphidonta*, Fischer. *Ceratostreon*, *Rhynchostreon*, Bayle, 1879.) Shell Chama-shaped, attached by the left valve; umbones subspiral, turned to the posterior side (*i. e.* reversed); right valve opercular. *O. Humboldtii*, Fischer

(cxxxii, 3). Fossil, 46 sp. L. Oolite—Chalk; United States, Europe.

ALECTRYONIA, Fischer de Waldheim, 1825. (Lopha, Bolten, 1798. Dendostrea, Swainson, 1840. Actinostrea, Bayle.) Shell plicate, strongly so towards the margins; adherent partly by recurved spinous processes clasping the limbs or roots of trees, as mangroves, etc. *O. frons*, Linn. (cxxxii, 79).

GRYPHÆA, Lamarck, 1801. (Pycnodonta, Fischer, 1835.) Shell free or very slightly attached; left valve with a prominent incurved umbo; right valve small, concave. Fossil, 30 sp. Liassic—Cretaceous; Eur., India, U. S. *O. angulata*, Lam. (cxxxii, 4).

GRYPHÆOSTREA, Conrad, MSS. Shell thin, elongate, straight, narrow; lower valve rather deep and smooth; upper valve flat or slightly concave, and ornamented with distant, regular, thin, concentric laminæ; beak of lower valve contorted, or turned to one side; cartilage-pit narrow, oblique. In perfectly preserved specimens the typical species, *O. vomer*, throws out long, slender auricular appendages (one on each side) from the lower valve near the beak. They are usually broken off, but appear to have attached the species.

MOLLUSCOIDA.

CLASS BRACHIOPODA.

The animals, and more especially the shells of this class of molluscoids, were for a long period regarded as belonging to true mollusca, and so uniformly are they still the objects of conchological study that a treatise upon that science would be very incomplete for practical use, if the Brachiopoda were excluded. On the other hand, the two other classes of Molluscoidea, the Tunicata and Bryozoa, are beyond the usual scope of conchological investigation, and as this work would be considerably increased in bulk and cost by the description and illustration of their systematic groups, they are omitted.

Steenstrup, Morse, Kowalevsky and other eminent investigators, have concluded, mainly from embryological data, that the brachiopods form a portion of the subkingdom Annulosa, and are nearly related to the annelids or worms. Dall and Stoliczka have maintained the molluscoid affinities of the class. Thomas Davidson, who has made a specialty of the study of the Brachiopoda, summarizes the arguments of these naturalists and thus concludes:

“No one can doubt that the brachiopods and Amphitrites possess many important characters in common after perusing the admirable observations upon the subject contained in Prof. Morse's memoir; but at the same time, as was remarked to me by Prof. Verrill, almost any invertebrate group may be annelidized by overrating certain points of its affinities; and it seems to me that one must not place entire confidence in any classification which is founded to so great an extent on embryological characters.”

Huxley writes: “The acceptance of the view originally propounded by Steenstrup and so ably urged by Professor Morse, respecting the affinities of the brachiopods with the worms, does not to my mind weaken the opinion I have always held as to their affinities with the Bryozoa on the one hand, and with the higher Mollusca on the other.”

To give even a succinct statement of the conflicting views of the authors first mentioned would unduly increase the number of my pages; those who wish to pursue the subject further may read with interest and profit:

E. S. Morse.—American Journal of Science and Arts, p. 100, July, 1870.

Proc. Bost. Soc. Nat. Hist., xv, 1873.

Memoirs Bost. Soc. Nat. Hist., ii, 29, 1871.

Wm. H. Dall.—Am. Jour. Conchology, vi, 88, 1871; vii, 39, 1872.

A. Agassiz.—Review of Kowalevsky's Memoir, Am. Jour. of Science and Arts, 3d ser., viii, 470, 1874 (Kowalevsky published in Russian).

F. Stoliczka.—Palæontologica Indica, vol. iv, Brachiopoda.

Davidson's paper, "What is a Brachiopod?" may also be consulted by those desirous of reading a fuller account of the group than is given in these pages. Geological Magazine (London), for 1877; or a French translation in Annales de la Société Malacologique de Belgique, x, 1876.

The Brachiopoda (= Order Palliobranchiata, Blainville, 1814) are bivalve molluscoids, which differ from the ordinary mussels, cockles, etc., in being always equal-sided and never quite equi-valve. Their forms are symmetrical, and so commonly resemble antique lamps, that they were called *lampades*, or "lamp-shells," by the old naturalists (Meuschen, 1787; Humphreys, 1797); the hole which in a lamp admits the wick serves in the lamp-shell for the passage of the pedicel by which it is attached to submarine objects.

The valves of the Brachiopoda are respectively dorsal and ventral; the ventral valve is usually largest, and has a prominent beak, by which it is attached, or through which the organ of adhesion passes. It is sometimes perforated, as in the Terebratulidæ. The dorsal or smaller valve is always free and imperforate. The valves are articulated by two curved teeth, developed from the margin of the ventral valve, and received by sockets in the other; this hinge is so complete that the valves cannot be separated without injury. A few genera have no hinge; in *Crania* and *Discina* the lower valve is flat, the upper like a limpet; the valves of *Lingula* are nearly equal, and have been compared to a duck's bill.

This and several other points of difference seem to show the propriety of adopting the proposal made by Deshayes in 1836 of

dividing the brachiopods into two great groups, the one having articulated, the other non-articulated valves. In the first, moreover, the valves are opened by muscles acting on the cardinal process of the dorsal valve, while in the latter the valves are opened by the pressure of the fluid in the perivisceral cavity. This difference is accompanied by a striking variation in the arrangement of the muscles. The articulated group possess an anal aperture; the unarticulated none.

The valves are both opened and closed by muscles (cxxxiv, 1); those which open the shell (cardinales) originate on each side the centre of the ventral valve, and converge towards the hinge-margin of the free valve, behind the dental sockets, where there is usually a prominent cardinal process. The teeth form the fulcrum on which the dorsal valve turns. The adductor muscles are four in number, and quite distinct in *Crania* and *Discina*; in *Lingula* the posterior pair are combined, and in *Terebratula* the four muscles are separate at their dorsal terminations, but united at their insertion in the centre of the larger valve. The pedicel is fixed by a pair of muscles (each doubly attached) to the dorsal hinge-plate, and by another pair to the ventral valve, outside the cardinal muscles.

In the *Terebratulidæ* and the other brachiopods having articulated valves the muscular system consists of three pairs of muscles which act directly on the valves, and of three pairs which connect the shell, and adjust it with respect to the peduncle. In the unarticulated brachiopods, such as *Lingula*, the muscles are more complicated than in the former group; three pairs of protractor muscles keep the valves together, and thus compensate for the absence of the hinge and condyles, which help to form this function in the articulated group; they are so arranged as to co-operate in preventing any displacement of the valves in any direction. Hence the term sliding-muscles which they have received is inappropriate, since they prevent any sliding action. In the lamellibranchs the sliding of the valves is admirably guarded against by means of hinges with teeth and sockets; in brachiopods the same end is apparently obtained by means of muscles.

The muscles are remarkably glistening and tendinous, except at their expanded ends, which are soft and fleshy. They are, with few exceptions, non-striated. In the posterior adductors of *Waldheimia* transverse striations are well displayed. Their impressions are often deep, and always characteristic; but difficult of interpretation from their complexity, their change of position, and the occasional suppression of some and combination of others. There may be considerable changes in arrangement of muscles without any important change in the internal

structure. Thus in *Waldheimia cranium* there are six muscular impressions in the dorsal valve; in *W. australis* there are only four, the other two muscles being attached to the hinge-plate, not to the valve. The valve and hinge-plate are never found together, and it is, therefore, probable that in the fossil species, the shells of which are found without hinge-plates, the muscles may have been arranged as in *W. cranium*.

On separating the valves of a recent Terebratula, the digestive organs and muscles are seen to occupy only a very small space near the beak of the shell, partitioned off from the general cavity by a strong membrane, in the centre of which is placed the animal's mouth. The large cavity is occupied by the fringed arms, the characteristic organs of the class. Their nature will be better understood by comparing them with the lips and labial tentacles of the ordinary bivalves; they are, in fact, lateral prolongations of the lips supported on muscular stalks, and are so long as to require being folded or coiled up. In Rhynchonella and Lingula the arms are spiral and separate; in Terebratula and Discina they are only spiral at the tips, and are united together by a membrane, so as to form a lobed disk. It has been conjectured that the living animals have the power of protruding their arms in search of food; but this supposition is unlikely, since in many genera they are supported by a brittle skeleton of shell, while the food is obtained by means of currents created by cilia. Lingula may have the power of slightly extending the arms. The internal skeleton consists of two spiral processes in the Spiriferidæ, whilst in Terebratula and Thecidium it takes the form of a loop, which supports the brachial membrane, but does not strictly follow the course of the arms. The mode in which the arms are folded is highly characteristic of the genera of Brachiopoda; the extent to which they are supported by a calcareous skeleton is of less importance, and liable to be modified by age. That margin of the oral arms which answers to the lower lip of an ordinary bivalve, is fringed with long filaments (cirri), as may be seen even in dry specimens of recent Terebratulæ. In some fossil examples the cirri themselves were supported by slender processes of shell; they cannot, therefore, be vibratile organs, but are probably themselves covered with microscopic cilia, like the oral tentacles of the ascidian polypes. The anterior lip and inner margin of the oral arms are plain, and form a narrow gutter along which the particles collected by the ciliary currents may be conveyed to the mouth. The object of the folding of the arms is obviously to give increased surface for the disposition of the cirri.

The mouth conducts by a narrow œsophagus to a simple stomach, which is surrounded by the large and granulated

liver; the intestine of *Lingula* is reflected dorsally, slightly convoluted, and terminates between the mantle-lobes on the right side. In *Orbicula* it is reflected ventrally, and passes straight to the right, ending as in *Lingula*. In *Terebratula*, *Rhynchonella*, and probably all the articulated Brachiopoda, the intestine is simple and reflected ventrally, passing through a notch or foramen in the hinge-plate, and ending behind the ventral insertion of the adductor muscle.

The circulatory system is far less complex than was formerly supposed, and does not differ greatly from the same system in the Tunicata. The heart is placed on the dorsal surface of the stomach, and consists of a simple, unilocular, pyriform vesicle without any auricle. From it the blood is propelled through four channels to the organs of reproduction and to the mantle; and its flow is probably assisted by a number of subsidiary pulsatile vesicles situated on the main arterial trunks. It then courses through the plexus of lacunes in the pallial sinuses and lobes; turns back through the lacunes of the parietes into the system of visceral lacunes. It probably enters the liver, and ultimately finds its way back into the heart through the branchio-systemic vein. There is, however, another and more important blood current, which traverses the whole length of the brachial canal, and penetrates to the extremities of the cirri, before it joins the current returning from the visceral lacunes and flows with it into the branchio-systemic vein. The blood which has passed through the brachial canal is far more highly oxygenated than the blood which has flowed through the pallial membranes. There seems to be strong evidence that the so-called arms, which serve to bring food to the creature's mouth by the means before noticed, also subserve the purpose of respiratory organs. The mantle is an accessory breathing-organ. It attains its highest development as such in *Lingula*, but even in this genus the brachial apparatus performs the chief part in oxygenating the blood.

There is another system of canals which take their rise from the visceral cavity. What its function is has not been determined; it is not the blood system as was formerly imagined, and has no connection with it. The perivisceral cavity and the visceral lacunes which diverge from it may, it is thought, be homologous to the water-vascular system in Polyzoa, the function of which is probably to evacuate the effete nitrogenized products which have been eliminated from the blood. Consequently it would perform the offices both of the kidney and the renal organs.

The generative organs occupy the great pallial sinuses, and the sexes are separate. In the articulated brachiopods the

ovaries and testes are placed in the mantle; but in *Lingula* and *Discina* they occur in the perivisceral chamber. The ova escape into the oviducts (regarded by Cuvier and others as hearts), which open externally, and have nothing to do with the vascular system. In *Rynchonella* there are four oviducts, but in most, if not all the other brachiopods, there are only two. In *Terebratulidæ* they are divided into two portions, called the auricle and ventricle by Professor Owen. Mature eggs have been found in large numbers in the perivisceral chamber and in the oviducts. Recent *Discinæ* often have minute fry attached to their valves, and Mr. Sness, of Vienna, has noticed a specimen of the fossil *Stringocephalus*, which contained numerous embryo shells.

As yet we know little respecting the development of the Brachiopoda, but in their first stage they are free and able to swim about until they meet with a suitable position. It is probable that in the second stage they all adhere by a byssus, which in most instances becomes consolidated, and forms a permanent organ of attachment. (Prof. Morse describes the embryo of *Terebratulina* with great minuteness during its six stages of development. It is divided into two, three, or four lobes clothed with vibratile cilia; and before becoming attached swims or whirls head foremost by means of the cilia covering the body.) Some of the extinct genera (*e. g.* *Spirifera* and *Strophomena*) appear to have become free when adult, or to have fixed themselves by some other means. Four genera, belonging to very distinct families, cement themselves to foreign objects by the substance of the ventral valve.

The nervous system exhibits a state of development but little superior to what is found in *Ascidians*. No special organs of sense have been detected. The red spots in the mantle, supposed by some to be rudimentary eyes and ears, are probably the glands situated at the base of the setæ.

Some of the Brachiopoda appear to attain their full growth in a single season, and all probably live many years after becoming adult. The growth of the valves takes place chiefly at the margin; adult shells are more globular than the young, and aged specimens still more so. The shell is also thickened by the deposit of internal layers, which sometimes entirely fill the beak, and every portion of the cavity of the interior which is not occupied by the animal, suggesting the notion that the creature must have died from the plethoric exercise of the calcifying function, converting its shell into a mausoleum, like many of the *ascidian* zoophytes.

The intimate structure of the shell of the Brachiopoda has been investigated by Mr. Morris, Professor King, and more

recently by Dr. Carpenter; according to this last observer, it consists of flattened prisms of considerable length, arranged parallel to each other with great regularity, and obliquely to the surfaces of the shell, the interior of which is imbricated by their out-crop. This structure is found only in the Rhynchonellidæ; but in most—perhaps all the other Brachiopoda—the shell is traversed by canals from one surface to the other, nearly vertically, and regularly, the distance and size of the perforations varying with the species (vol. i, t. 1, f. 5). Their external orifices are trumpet-shaped, the inner often very small; sometimes they bifurcate towards the exterior, and in *Crania* they become arborescent. The canals are occupied by cœcal processes of the outer mantle-layer, and are covered externally by a thickening of the epidermis. Mr. Huxley has suggested that these cœca are analogous to the vascular processes by which in many ascidians the tunic adheres to the test; the extent of which adhesion varies in closely allied genera. The large tubular spines of the *Productidæ* must have been also lined by prolongations of the mantle; but their development was more probably related to the maintenance of the shell in a fixed position, than to the internal economy of the animal.—KING. Dr. Carpenter states that the shell of the Brachiopoda generally contains less animal matter than other bivalves; but that *Discina* and *Lingula* consist almost entirely of a horny animal substance, which is laminar, and penetrated by oblique tubuli of extreme minuteness. He has also shown that there is not in these shells that distinction between the outer and inner layers, either in structure or mode of growth, which prevails among the ordinary bivalves; the inner layers only differ in the minute size of the perforations, and the whole thickness corresponds with the outer layer only in the *Lamellibranchiata*. The loop, or brachial processes, are always impunctate. Mr. Hancock's researches would tend to show that these conclusions are generally correct, but not entirely so. "When the shell is dissolved in acid the free border [of the mantle] which projects beyond the marginal fold, and which is applied to the extreme edge of the shell, can be examined with advantage. The pallial cœca are then completely exposed appended to the membrane in various stages of development, and the spaces between them are found studded all over with rather large, clear, oval, cell-like spots, which are arranged with considerable regularity in rows, so that those in the approximate rows alternate. These spots apparently correspond to the bases of the prismatic columns of the shell; and if it be allowed that they represent spaces in which calcareous granules had been accumulated, it is easy to understand how the fibrous or columnar structure is formed. A succession of layers of such

accumulated granules deposited one after the other would result in the peculiar shell formation of the Brachiopoda." The extremities of the prisms are not visible on the external surface, but in the young individual of some species, as *Terebratula caput-serpentis*, there is a thin layer of calcareous matter, which seems to show that in some brachiopods the shell is composed of two layers of shell, having a different structure, as in the case of the Conchifera.

The Lamp-shells are all natives of the sea. They are found hanging from the branches of corals, the under sides of shelving rocks, and the cavities of other shells. Specimens obtained from rocky situations are frequently distorted, and those from stony and gravelly beds, where there is motion in the waters, have the beak worn, the foramen large, and the ornamental sculpturing of the valves less sharply finished. On clay beds, as in the deep clay strata, they are seldom found; but where the bottom consists of calcareous mud they appear to be very abundant, mooring themselves to every hard substance on the sea-bed, and clustering one upon the other.

Of all mollusca the Brachiopoda enjoy the greatest range both of climate, and depth, and time; they are found in tropical and polar seas; in pools left by the ebbing tide, and at the greatest depths hitherto explored by the dredge. At present comparatively few recent species are known; but many more will probably be found by dredging in the deep sea, which these shells mostly inhabit. The number of living species is already greater than has been discovered in any *secondary* stratum, but the vast abundance of fossil *specimens* has made them seem more important than the living types, which are still rare in the cabinets of collectors, though far from being so in the sea. Above 4000 extinct species of Brachiopoda have been described, of which a large proportion are found in Europe. They are distributed throughout all the sedimentary rocks of marine origin from the Cambrian strata upwards, and appear to have attained their maximum of specific development in the Silurian age. Some species (like *Atrypa reticularis*) extend through a whole "system" of rocks, and abound equally in both hemispheres; others (like *Spirifera striata*) range from the Cordillera to the Ural mountains. One recent *Terebratula* (*caput-serpentis*) made its appearance in the Miocene Tertiary; whilst others, scarcely distinguishable from it, are found in the Upper Oolite and throughout the Chalk series and London Clay.—WOODWARD.

Geological Distribution of the Families of Brachiopods.

	Cambrian.	Silurian.	Devonian.	Carboniferous.	Permian.	Triassic.	Jurassic.	Cretaceous.	Tertiary.	Recent.
ARTHROPOMATA.										
Terebratulidæ,		*	*	*	*	*	*	*	*	*
Thecideidæ,				*	*			*	*	*
Stringocephalidæ,			*			*	*	*	*	*
Rhynchonellidæ,		*	*	*	*	*	*	*	*	*
Atrypidæ,		*	*	*	*	*	*			
Spiriferidæ,		*	*	*	*	*	*			
Koninckinidæ,			*			*	*			
Strophomenidæ,	*	*	*	*	*	*	*			
Ptodontidæ,		*	*	*	*					
LYOPOMATA.										
Craniadæ,		*	*	*	*	*	*	*	*	*
Trimerellidæ,		*	*	*	*	*	*	*	*	*
Discinidæ,	*	*	*	*	*	*	*	*	*	*
Obolidæ,	*	*	*	*	*	*	*	*	*	*
Lingulidæ,	*	*	*	*	*	*	*	*	*	*

ORDER ARTHROPOMATA.

(Apygia, Bronn. Articulata, Huxley.)

Shell testaceous, articulated by hinge-teeth, with usually an internal skeleton-like testaceous process. Animal destitute of an anal aperture (Clistenterata, King).

FAMILY TEREBRATULIDÆ.

Shell minutely punctate; usually round or oval, smooth or striated; ventral valve with a prominent beak, perforated near or at the apex, and attached by a peduncle passing through the perforation, or by a portion of the valve itself; hinge with two curved teeth; dorsal valve with a depressed umbo, a prominent cardinal process between the dental sockets, and a slender shelly loop.

Animal attached by a pedicel, or by the ventral valve; oral arms united to each other by a membrane, variously folded; sometimes spiral at their extremities.

TEREBRATULA, Müller, 1776.

Etyim.—Diminutive of *terebratus*, perforated. Lamp-shell.

Syn.—Lampas, Humph., 1797. Gryphus, Muhlfeldt, 1811. Epithyris, Phil., 1841. Liothyris, Douvillé, 1879.

Distr.—8 sp. West Indies, Mediterranean; 90–250 fathoms on nullipore mud. (Forbes.) Vigo Bay, Falkland Islands, Japan. Fossil, very numerous species. Triassic—; world-wide. *T. maxillata*, Sowb. (cxxxiv, 2). *T. vitrea*, Linn. (cxxxiv, 6, 7). *T. sella*, Sowb. (cxxxiv, 5). *T. Phillipsii*, Morris (cxxxiv, 3, 4).

Shell smooth, convex; beak truncated and perforated; foramen circular; deltidium of two pieces frequently blended; loop very short, simple, attached by its crura to the hinge-plate.

Animal attached by a pedicel; brachial disk trilobed, centre lobe elongated and spirally convoluted.

Douvillé has proposed the name Liothyris for shells without folds, like *T. vitrea*, L. (cxxxiv, 6, 7), but there are so many intermediate stages that the division cannot be maintained; some young individuals are unfolded, but acquire the folds in growth.

PYGOPE, Link, 1830. (Diphytes Schröt., 1779. Antinomia, Catullo, 1850. Pugites, DeHaan, 1833. Glossothyris, Douvillé, 1879.) Ventral valve bilobed when young; when adult, the lobes unite, leaving a round hole in the centre of the shell. Jurassic and Cretaceous; Southern Europe. *T. diphyoides*, d'Orb. (cxxxiv, 8–10). *T. diphya*, Colonna (cxxxiv, 11).

DICTYOTHYRIS, Douvillé, 1879. Ventral valve two-folded with a median depression; dorsal valve with a strong median swelling, bordered by channels; surface radiately striate, crossed by concentric growth-lines forming tubercles at their intersection. Jurassic and Cretaceous.

CÆNOTHYRIS, Douvillé, 1879. Shell oval, smooth; tooth-plate strongly developed; apophyses independent of the cardinal teeth, from which they are separated by a diverging slit; a septum present, as in Waldheimia. *T. vulgaris*, Schloth. (cxxxiv, 12).

DIELASMA, King, 1859.

Syn.—Epithyris, King (part), 1850. Seminula, M'Coy (part), 1855. Cryptacanthia, White and St. John, 1868.

Distr.—Permian—; Eur., N. Am. *D. elongata*, Schloth. (cxxxiv, 13).

Shell with lamellæ supporting the teeth of the neural valve, a short loop as in Terebratula but more abruptly sinuated anteriorly, and with the central lamina of the hinge-plate in the hæmal valve produced in the form of a mason's trowel, and supported beneath by a mesial septum.

TEREBRATULINA, d'Orbigny, 1847.

Syn.—Agulhasia, King, 1871.

Distr.—8 sp. United States, Norway, Australia, Cape, Japan;

10-120 fathoms. Fossil, 22 sp. Jurassic—; United States, Europe. *T. caput-serpentis*, Linn. (cxxxiv, 14-16).

Shell finely dichotomously striated, auriculate, deltidium usually rudimental; foramen incomplete; loop short, rendered annular in the adult by the union of the oral processes.

WALDHEIMIA, King, 1849.

Syn.—Magellania, Bayle, 1880.

Distr.—9 sp. Norway, W. Indies, Java, Australia, California, Cape Horn; low-water—100 fathoms. Fossil, 90 sp. Carb.—; South America, Europe. *W. Australis*, Quoy (cxxxiv, 1, 17-19). *W. flavescens*, Lam. (cxxxiv, 20-22).

Shell smooth or plaited, dorsal valve frequently impressed; foramen complete; loop elongated and reflected; septum of smaller valve elongated.

WALDHEIMIA (restricted), Dall, 1871. Shell globose, neural beak more or less produced; foramen complete or incomplete; deltidia separated or united; pedunculated; a ridge or septum usually existing in the hæmal valve. Mouth behind the brachia, which consist of two lateral lobes and a central spiral lobe. *W. flavescens*, Lam.

EUDESIA, King, 1850. Shell swollen, oval; valves sharply plaited; beak-opening round, large; median septum and tooth-plates developed. *W. Grayi*, Davidson, and 6 fossil sp.

MACANDREVIA, King, 1859. (? Gwynia, King, 1859. Neothyris and Plesiothyris, Douvillé, 1879.) Smooth, longitudinally oval, inequivalve, the condyle valve being the largest; foramen emarginated by the deltidial fissure; umbonal cavity of large valve furnished with two muscular fulcral plates passing somewhat perpendicularly from the dental protuberances to the surface of the valve; umbonal cavity of opposite valve also furnished with similarly directed plates; cardinal muscular fulcrum excavated in the substance of the hinge; loop long, strongly recurved, and extending in front of the centre of the valve. Includes the recent *W. cranium*, Müll., which is the type, and a number of fossil forms.

ZEILLERIA, Bayle, 1879. (Macandrewia, Schloen. Orthotoma, Quenst., 1871.) Differs from Waldheimia in the presence of two rostral partitions upon the hinge. Jurassic—Tertiary; Europe. *W. lagenalis*, Schloth. (cxxxiv, 23).

AULACOTHYRIS, Douvillé, 1879. Apophyses, rostral partitions and septum as in Zeilleria; foramen generally small and oblong. Distinguished by its exterior form, the smaller valve having a median furrow. Triassic, Jurassic, Cretaceous. *W. resupinata*, Sowb. (cxxxv, 24).

ANTIPTYCHINA, Zittel, 1880. Large valve swollen in the middle, with a strong fold on either side; small valve usually somewhat

flatter, with a deep marginal sinus, folded in the middle; loop very long, fringed, the blades widened near the connecting bridge; septum strong. Jurassic, Cretaceous. *W. bivallata*, Deslong.

CRYPTONELLA, Hall, 1867. Loop exactly resembling that of *Waldheimia* proper, except in the addition of a transverse band from one side of the apophyses to the other behind the crura. Devonian. *W. rectirostra*, Hall.

MEGANTERIS, Suess, 1856. Shell orbiculate, somewhat compressed, nearly equivalve; area of neural valve small, apex inconspicuous, minutely foraminated, punctate; deltidia small, wide, united; cardinal process prominent, with a V-shaped process near the apex for the insertion of the cardinal muscles, sulcated on each side, with the base excavated; cardinal border broad, wide, rugose; loop essentially as in *Waldheimia*, but with very long crura, the main stems of the apophyses being given off at a sharp angle with the crura, reflected abruptly and the posterior part of the reflected loop behind and below the crura; there is a faint mesial septum in the hæmal valve. Sil.; N. Am. Dev.; Eur. *W. Archiaci*, Suess.

CENTRONELLA, Billings, 1859.

Etym.—Diminutive of *kentron*, a spur.

Syn.—Cryptonella, Hall (part).

Distr.—4 sp. Devonian; North America. *C. glans-fagea*, Hall (cxxxv, 25, 26).

Shell having the general form of *Terebratula*. Dorsal valve with a loop consisting of two riband-like lamellæ, which were united at an acute angle at the point of greatest extension, whence they recurve in a thin vertical plate which is not attached at either margin.

LEPTOCCELIA, Hall, 1859. Appears to differ from *Centronella* only in consisting of species which have the surface ribbed instead of smooth. 9 sp. Mid. Silurian—Devonian; Europe, North America. No true *Terebratulæ* have been found in beds older than the Devonian. *L. imbricata*, Hall.

? HINNIPHORIA, Suess, 1858. *H. globularis*, Suess. Jurassic; Stramberg.

RENSSELÆRIA, Hall, 1859.

Etym.—Dedicated to the late Hon. Stephen Van Rensselaer.

Syn.—*Atrypa*, Conr., 1839. *Pentamerus*, Vanuxem, 1843.

Distr.—Fossil, 11 sp. Silurian—Devonian; Europe, N. Am. *R. ovoides*, Hall (cxxxv, 27).

Shell ovoid or suborbicular, without mesial fold or sinus; beak prominent, acute, more or less incurved; foramen terminal, sometimes concealed. Ventral valve with two diverging cardinal teeth supported by strong dental plates. Dorsal valve with the dental sockets between the shell and a strong process from which

the slender crura proceed, first in a direct line, and then one division of each, diverging into the centre of the ventral valve, terminate in acute points. On the other side the divisions extend nearly at right-angles to the axis of the shell into the cavity of the dorsal valve; and thence bending abruptly forward and gradually converging, terminate above the centre of the shell in a thin flattened or longitudinally concave plate.

TEREBRATELLA, d'Orbigny, 1847.

Syn.—Delthyris, Menke, 1830. Ismenia, King, 1850.

Distr.—Excluding subgenera, 12 sp. Cape Horn, Valparaiso (ninety fathoms), New Zealand, Japan, California, Ochotsk, Spitzbergen, Labrador. Fossil, 16 sp. Lias—; United States, Europe. *T. Magellanica*, Chemn. (cxxxv, 28, 29).

Shell smooth or radiately plaited; dorsal valve longitudinally impressed; hinge-line straight, or not much curved; beak with a flattened area on each side of the deltidium; foramen large; deltidium incomplete; loop attached to the septum.

Animal like Terebratula; the spiral lobe of the brachial disk becomes very diminutive in some species, and is obsolete in *T. Cumingii*.

WALTONIA, Davidson, 1850. Shell with the beak truncated by a large incomplete foramen; deltidia separate. Loop reduced to two simple lamellæ furnished with oral processes and attached to a prominent central septum. *T. Valenciennesii*, Davidson. Perhaps the fry of *Ter. rubicunda*, with the reflected part of the loop wanting.

TRIGONOSEMUS, König, 1825. (Delthyridea, King, 1850. Fissirostra, d'Orbigny, 1847.) Shell finely plaited, beak prominent, curved, with a narrow apical foramen; cardinal area large, triangular; deltidium solid, flat; cardinal process very prominent. 5 sp. Chalk; Europe. *T. elegans*, König (cxxxv, 30–32). *T. Palissii*, Wood (cxxxv, 33).

LYRA, Cumberland, 1816. (Terebrirostra, d'Orb, 1847.) Shell ornamented with rounded ribs; beak very long, divided lengthwise internally by the dental plates; loop doubly attached? 4 sp. Cretaceous; Europe. Three species of similar form are found in the Trias of St. Cassian. *T. lyra*, Sowb. (cxxxv, 34, 35). *T. neocomiensis*, d'Orb. (cxxxv, 36).

MEGERLIA King, 1850. (Muhlfeldtia, Bayle, 1880.) Loop trebly attached; to the hinge-plate by its crura. and to the septum by processes from the diverging and reflected portions of the loop. 3 sp. Mediterranean, Philippines. Fossil, 7 sp. Chalk—. *T. truncata*, Lam. (cxxxv. 37–39).

LAQUEUS, Dall, 1870. Shell with the reflected portion of the loop attached by slender processes, on each side, to the hæmal processes, at or near the points where the two septal processes

branch off to the septum; foramen complete. 2 sp. Cal., Japan. *T. Californica*, Koch (cxxxv, 40).

KINGENA, Davidson, 1852. Posterior part of the reflected portion of the loop broad, angulated, with the two angles bent down on each side and joined to the septum directly (not to the hæmal or septal processes), forming a broad ring, only intersected by the septum; exterior granulated; foramen entire. *T. lima*, DeFrance (cxxxv, 43, 44). Cret.; Europe.

MAGAS, Sowb., 1816. (*Mannia*, Dewalque, 1874) Shell smooth, conspicuously punctate, dorsal valve impressed, foramen angular, deltidium rudimentary; internal septum prominent, touching the ventral valve; reflected portions of the loop disunited. 3 sp. U. Greensand—Chalk; Europe. Recent, 2 sp. New Zealand, Canaries. *T. pumila*, Sowb. (cxxxv, 48, 49).

RHYNCHORA, Dalm., 1828. Like Magas, but hinge-margin long, straight, the large valve with an area. Cretaceous. *T. costata*, Dalm.

MAGASELLA, Dall, 1870. Shell with the reflected portions of the apophyses united, forming a loop. Comprises most of the recent species of Magas. *T. Evansii*, Dav. 11 sp. N. Zealand.

ISMENIA, Gray, 1863. (*Frenula*, Dall, 1871.) Shell externally resembling Terebratella; apophyses broad and short, attached first by the septal process to a short stout septum, then recurved, the broad posterior edges of the reflected portion touching and blending with the septal processes and the adjacent part of the hæmal processes, forming a funnel-shaped ring, into which the septum does not project; the lateral loops of the apophyses remain open in the adult. Brachia without a median spiral lobe. Recent; *T. sanguinea*, Chemn. Fossil; *Ismenia pectunculus*, Gray. Oxford Clay; France.

BOUCHARDIA, Davidson, 1849.

Distr.—2 sp. Brazil, 13 fathoms. *B. tulipa*, Blainv. (cxxxv, 45–47).

Beak prominent, with a minute apical foramen; deltidium blended with the shell; apophyses anchor-shaped, the septum being furnished with two short lamellæ.

PLATIDEA, Costa, 1852.

Syn.—Morrisia, Davidson, 1852.

Distr.—3 sp. Mediterranean, W. Ind., Isle Bourbon. Fossil, 4 sp. Chalk—; Europe. *P. anomioides*, Scacchi (cxxxv, 50–52).

Shell minute, conspicuously punctate; foramen large, encroaching equally on both valves; hinge-area small, straight; loop not reflected, attached to a small forked process in the centre of the valve.

Animal with sigmoid arms, destitute of spiral terminations; cirri in pairs.

KRAUSSINA, Davidson, 1859.

Syn.—Kraussia, Davidson, not Dana, 1852.

Distr.—6 sp. South Africa, Sydney, New Zealand; low-water to 120 fathoms. *K. rubra*, Pallas (cxxxv, 53, 54).

Shell transversely oblong; hinge-line nearly straight; beak truncated, laterally keeled; area flat; foramen large, deltidium rudimentary; dorsal valve longitudinally impressed, furnished inside with a forked process rising nearly centrally from the septum; interior often strongly tuberculated. The apophyses are sometimes a little branched.

Animal with rather small oral arms, the spiral lobe very diminutive.

ARGIOPE, Eudes Deslongchamps, 1842.

Etym.—*Argiope*, a nymph. *Syn.*—Megathyris, d'Orb., 1847.

Distr.—5 sp. North Britain, Madeira, Canaries, Mediterranean; 30–105 fathoms. Fossil, 19 sp. Oolite—; Europe. *A. decollata*, Chemn. (cxxxvi, 60–63).

Shell minute, transversely oblong or semioval, smooth or with corresponding ribs; hinge-line wide and straight, with a narrow area to each valve; foramen large, deltidium rudimentary; interior of dorsal valve with one or more prominent, submarginal septa; loop two- or four-lobed, adhering to the septa, and more or less confluent with the valve.

Animal with oral arms folded into two or four lobes, united by membrane, forming a brachial disk fringed with long cirri; mantle extending to the margins of the valves, closely adherent.

CISTELLA, Gray, 1853. (*Zellania*, Moore, 1855.) Shell minute orthiform; texture fibrous; hinge-area short, foramen angular, encroaching on both valves; interior of dorsal valve as in *Thecidium*, with a single central septum and broad margin. Recent. 7 sp. Fossil, 3 sp. Lias—Great Oolite; Britain. *A. Davidsoni*, Moore (cxxxvi, 64, 65).

FAMILY STRINGOCEPHALIDÆ.

Shell suborbicular, the hinge-margin rounded; the under valve with a deltidium and opening under the prominent beak; cardinal process very large, almost touching the opposite valve; loop attached to the crura by their neural edges.

STRINGOCEPHALUS, DeFrance, 1824.

Etym.—*Strinx* (*stringos*), an owl; *cephale*, the head.

Distr.—*S. Burtini*, DeFrance (cxxxvi, 55, 56, 66, 67). 2 sp. Silurian, Devonian; Europe.

Shell punctate; suborbicular, with a prominent beak; ventral

valve with a longitudinal septum in the middle; hinge-area distinct; foramen large and angular in the young shell, gradually surrounded by the deltidium, and rendered small and oval in the adult; deltidium composed of three elements; teeth prominent; dorsal valve depressed, cardinal process very prominent, sometimes touching the opposite valve, its extremity forked to receive the ventral septum; hinge-plate supporting a shelly loop, after the manner of *Argiope*.

CRYPTACANTHIA, White and St. John, 1868. "The loop seems to be essentially like that of *Waldheimia* in form, but the crura of the loop appear to be joined, * * * and the loop-band is armed with numerous spines which point outward toward the shell (?) in all directions." *S. compacta*, W. and St. J. Carb.; Iowa.

FAMILY THECIDIIDÆ.

Shell (perforate when young?) attached by the neural valve when adult. Brachia lobed, not spiral. Shell articulated by teeth, sockets and a cardinal process.

THECIDIA, DeFrance, 1828.

Etym.—*Thekidion*, a small pouch.

Syn.—*Bactrynum*, Emmerich. *Pterophloios*, Gumbel. *Thecidium*, Sowb.

Distr.—2 sp. Mediterranean, W. Indies. Fossil, 34 sp. Trias—; Europe. *T. papillata*, Schloth. (cxxxvi, 57–59).

Shell small, thick, punctate, attached by the beak, hinge-area flat; deltidium triangular, indistinct; dorsal valve rounded, depressed: interior with a broad granulated margin; cardinal process prominent, between the dental sockets; oral processes united, forming a bridge over the small and deep visceral cavity; disk grooved for the reception of the loop, the grooves separated by branches from a central septum; loop often unsymmetrical, lobed, and united more or less intimately with the sides of the grooves; ventral valve deeply excavated, hinge-teeth prominent; cavities for the adductor and pedicel muscles small; disk occupied by two large, smooth impressions of the cardinal muscles, bordered by a vascular line.

Animal with elongated oral arms, folded on themselves and fringed with long cirri; mantle extending to the margin of the valves and closely adherent; epidermis distinct.

FAMILY RHYNCHONELLIDÆ.

Shell impunctate, oblong, or trigonal, beaked; hinge-line curved; no area; valves articulated, convex, often sharply plaited; foramen beneath the beak, usually completed by a deltidium, sometimes concealed; hinge-teeth supported by dental plates; hinge-

plate deeply divided, supporting oral lamellæ, rarely provided with spiral processes; muscular impressions grouped as in *Terebratula*; vascular impressions consisting of two principal trunks in each valve, narrow, dichotomizing, angular, the principal posterior branches inclosing ovarian spaces.

Animal (of *Rhynchonella*) with elongated spiral arms, directed inwards, towards the concavity of the dorsal valve; alimentary canal terminating behind the insertion of the adductor in the ventral valve; mantle not adhering, its margin fringed with a few short setæ.

RHYNCHONELLA, Fischer, 1809.

Syn.—*Hypothyris*, Phil., 1841. *Hemithyris*, d'Orbigny, 1847. *Cyclothyris*, M'Coy, 1844. *Trigonella* (part), Fischer, 1809 (not *L. nor Dacosta*). *Stenochisma*, Hall (part), 1847. *Rhyncotrema*, Hall, 1860.

Distr.—6 sp. *R. psittacea*, Chemn. (cxxxvi, 69–71). Labrador (low-water?), Hudson's Bay (100 fathoms), Melville Island, Sitka, Icy Sea. *R. nigricans*, Sby. (cxxxvi, 72). New Zealand, 19 fathoms. Fossil, 500 sp. Lower Silurian—; North and South America, Europe, Thibet, China. *R. vespertilio*, d'Orb. (cxxxvi, 68).

Shell trigonal, acutely beaked, usually plaited; dorsal valve elevated in front, depressed at the sides; ventral valve flattened, or hollowed along the centre, hinge-plates supporting two slender curved lamellæ; dental plates diverging.

The foramen is at first only an angular notch in the hinge-line of the ventral valve, but the growth of the deltidium usually renders it complete in the adult shell; in the cretaceous species it is tubular. In *R. acuminata* (cxxxvi, 73, 74), and many other palæozoic examples, the beak is so closely incurved as to allow no space for a pedicel. Both the recent *Rhynchonellæ* are black; *R. octoplicata* of the Chalk sometimes retains six dark spots.

ACANTHOTHYRIS, d'Orb., 1850. Exterior surface spinous. *R. spinosa*, Schloth. (cxxxvi, 75). Jurassic.

RHYNCHOPORA, King, 1856. Valves having a punctate structure. *R. Geinitziana*, Vern. Dyas.

LEIORHYNCHUS, Hall, 1860. Proposed for forms marked by plications on the mesial fold and sinus, and sometimes with obscure or distinct plications on the lateral portions of the shell. 13 sp. Devonian; United States.

EATONIA, Hall, 1859.

Etym.—Dedicated to the late Professor Amos Eaton.

Syn.—*Elonia*, Meek and Worthen.

Distr.—Fossil, 7 sp. Upper Silurian; United States. *E. medialis*, Hall (cxxxvi, 76–79).

Shell like that of *Rhynchonella*; the lower half of the ventral valve with a broad, deep sinus. Valves articulating by means of two teeth in the ventral valve, with corresponding sockets in the dorsal valve, and a median septum embraced between the deeply bifurcating cardinal process of the opposite one.

Dorsal valve with four crural processes; in the ventral valve the dental plates are represented by elevated lamellæ surrounding the muscular impression, which is much stronger and differs in some respects from that of *Rhynchonella*.

DIMERELLA, Zittel, 1870.

Syn.—*Cryptopora*, Jeffreys, 1869. *Atretia*, Jeffreys, 1876.

Distr.—Recent. *D. gnomon*, Jeffreys. Europe. Fossil; Triassic.

Shell small, *Rhynchonelloid*, impunctate, with a large foramen; neural valve with an entire edge without a septum; hæmal valve with a large, very prominent septum, which divides the cavity of the shell, when closed, into two chambers; with two stout, diverging hook-shaped crura as in *Rhynchonella*.

RHYNCHONELLINA, Gemellaro, 1871.

Distr.—4 sp. Jurassic; Sicily. *R. Suessi*, Gemm.

Shell quadrangular or triangular, smooth or radially ribbed, hinge-margin nearly straight; large valve swollen, with curved beak, a large triangular area, with a rudimentary deltidium and oval opening; teeth and pits as in *Rhynchonella*; upper valve less swollen or flattish, with two very long crura, almost reaching the opposite valve, these crura sometimes provided, near the hinge, with sickle-shaped processes.

STRICKLANDINIA, Billings, 1863.

Etym.—Dedicated to the late Professor H. E. Strickland.

Syn.—*Stricklandia*, Billings, 1859 (non Buckman). *Rensselaeria* (pars), Hall, 1859.

Distr.—10 sp. Silurian; N. America, England. *S. elongata*, Vanuxem, is the only species known in the Devonian rocks. *S. lens*, Billings (cxxxvi, 80, 81).

Shell usually large, elongate-oval, etc.; valves nearly equal, never globose; a short mesial septum in the interior of the ventral valve supporting a small triangular chamber beneath the beak as in *Pentamerus*; in the dorsal valve no longitudinal septa, spires, or loop, the whole of the internal solid organs consisting of two short or rudimentary dental plates, which in some species bear prolonged calcified processes for the support of the cirrated arms. A more or less developed area in the ventral valve.

In *S. lævis* and *S. microcamerus* the hinge-line is straight and much extended. In *S. Arachne*, Billings, the area of the ventral

valve is so much developed as to give the whole shell the external appearance of an Orthid.

CAMERELLA, Billings, 1859.

Syn.—Triplesia, Hall, 1859.

Distr.—9 sp. Lower Silurian; North America. *C. Volborthi*, Billings.

Ventral valve with a small triangular chamber beneath the beak, supported by a short mesial septum as in Pentamerus. Dorsal valve with a single mesial septum and two short lamellæ for the support of the oral appendages, as in Rhynchonella. Surface smooth or obscurely plicated.

EICHWALDIA, Billings, 1858.

Etym.—Dedicated to Professor Eichwald, the celebrated Russian palæontologist.

Distr.—3 sp. Silurian; Canada, England. *E. subtrigonalis*, Billings.

Shell with the ventral valve perforated on the umbo for the passage of a peduncle; the place of the foramen beneath the beak being occupied by an imperforate concave plate; the interior of each valve divided by a medio-longitudinal ridge, that of the dorsal valve very prominent; hinge and teeth sockets wanting.

The internal structure of the ventral valve somewhat resembles that of Pentamerus or Camarophoria.

CAMAROPHORIA, King, 1844.

Distr.—Fossil, 9 sp. Carb.—Permian (Magnesian limestone); Germany and England, N. America. *C. Schlotheimi*, Busch (cxxxvi, 82). *C. crumena*, Martin (cxxxvi, 83, 84).

Ventral valve with converging dental plates supported on a low septal ridge; dorsal valve with a prominent septum supporting a spoon-shaped central process; oral lamellæ long and slender. Foramen angular, cardinal process distinct.

PENTAMERUS, Sowerby, 1813.

Etym.—*Pentameres*, five-partite.

Distr.—Fossil, 52 sp. Upper Silurian—Devonian; Arctic America, United States, Europe. *P. Knightii*, Sby. (cxxxvi, 85–87).

Shell impunctate, ovate, ventricose, with a large incurved beak; valves usually plaited; foramen angular; no area or deltidium; dental plates converging, trough-like, supported on a prominent septum; dorsal valve with two contiguous longitudinal septa opposed to the plates of the other valve.

Oral lamellæ have been detected by Mr. Salter in *P. liratus*;

in *P. ? brevirostris* (Devonian, Newton) the dorsal valve has a long trough-like process supported by a single low septum.

GYPIDIA, Dalman, 1828. *P. conchidium*, Dalm. Gotland. U. Silurian.

PENTAMERELLA, Hall, 1867. Ovately rounded, with a sinus on the ventral and a mesial fold on the dorsal valve; dorsal valve with the crura conjoined so as to form a separate trough-shaped cavity, which unites with the inner surface of the valve; a narrow area on each side of the fissure, and a flattened space or false area along the cardinal margin of the valve. Devonian; N. Am. *P. arata*, Conr.

GYPIDULA, Hall, 1867. Short, gibbous or ventricose; ventral valve much the larger, with or without mesial fold, a large fissure, and elongate, much incurved, trough-shaped pit; dorsal valve depressed in front; an area on both valves, that of the ventral valve striate, as in *Spirifera*; lamellæ of dorsal valve separate and diverging. Devonian; North America. *P. occidentalis*, Hall.

ANASTROPHIA, Hall, 1867. (*Brachymerus*, Shaler, 1865, preoc. Coleopt.) Rotund or gibbous, with the valves, as in ordinary *Pentamerus*, reversed; ventral valve smaller, gibbous in its upper part, depressed or sinuate below, with the V-shaped pit sessile for nearly its entire length; a small flattened space on each side of the fissure; dorsal valve ventricose, larger than the ventral, with prominent umbo; hinge-plate extended in gradually converging vertical lamellæ, which are joined to the shell throughout their length, whilst the crura are extended into the cavity in thin, free lamellæ. Silurian; North America. *P. Verneuli*, Hall.

AMPHIGENIA, Hall, 1867. Elongate, not lobed, ventral valve with connected dental lamellæ, forming a trough supported on a septum; dorsal valve with free crura; no area; shell-structure punctate. *P. elongata*, Vanuxem. Devon.; U. S.

? *CLOBINDA*, Barrande. Silurian; Bohemia.

FAMILY ATRYPIDÆ.

Shell fibrous; beak curved; hinge-margin curved, with strong teeth, without area; dorsal valve with two spirally coiled lamellæ, the points directed towards the middle of the opposite valve.

ATRYPA, Dalman, 1828.

Syn.—*Cleiothyris*, Phillips, 1841. *Spirigerina*, d'Orb., 1847.

Distr.—Fossil, 21 sp. Lower Silurian—Trias; America (Wellington Channel! Falkland Islands), Europe, Thibet. *A. reticularis*, Linn. (cxxxvi, 88–91).

Shell impunctate; oval, usually plaited and ornamented with squamose lines of growth; dorsal valve gibbose; ventral

depressed in front; beak small, often closely incurved; foramen round, sometimes completed by a deltidium, often concealed; dorsal valve with a divided hinge-plate, supporting two broad spirally coiled lamellæ; spires vertical, closely appressed, and directed towards the centre of the valve; teeth and impressions like *Rhynchonella*.

The shells of this genus differ from *Rhynchonella* chiefly in the calcification of the oral supports, a character of uncertain value.

The internal appendages of *Atrypa reticularis* consist of a pair of spiral cones, placed side by side, with their apices directed towards the cavity of the dorsal valve; the lamellæ have their origin on the socket-walls, and run parallel with the inner margin of the valve. "The spiral cones are connected by an entire and continuous loop, which is confined to the rostral part of the shell. The loop arises from the posterior portion of the first volutions of the spires, and curves gently forward and upward; the central or elevated portion is situated between and behind the cones, and forms a more or less abrupt curve, or is prolonged into a point directed towards the dorsal valve. The existence and form of this loop have been ascertained in several different varieties of *A. reticularis*, as well as in *A. spinosa*, Hall."—WHITFIELD.

CÆLOSPIRA, Hall, 1863. Shell fibrous, concavo-convex; spiral lamellæ with their bases turned towards the ventral, their points towards the dorsal valve. *A. camilla*, Hall (cxxxvii, 92).

STENOSCHISMA, Hall, 1847. (*Zygospira*, Hall, 1862.) Spiral cones connected by an entire and continuous loop in a very similar manner to that shown to exist in *Atrypa reticularis*; but the loop having its connection with the spiral lamellæ at a point relatively more distant from their origin on the hinge-plate, and passing over or in front of the spires. *A. modesta*, Say. Silurian; U. S.

GLASSIA, Davidson, 1881.

Distr.—3 sp. Silurian; England. *G. Whidbornei*, Davidson (cxxxvii, 93).

Principal lamellæ, forming the first coils of the spirals, connected at a short distance from the attachment to the hinge-plate by a ribbon-shaped lamella or loop; this loop, commencing on each side from the principal lamellæ, converges downwards in the shape of the letter V; principal coils of the spirals directly face the lateral margins; the ends of the spirals meet each other in the centre of the shell; each spiral consists of four coils.

ANAZYGA, Davidson, 1882.

Distr.—*A. recurvirostra*, Hall (cxxxvii, 94). Trenton limestone, Canada.

Shell small, longitudinally oval, radiately striated; position

of the spiral cones in the type same as in *Zygospira*, the base of each spiral cone being obliquely inclined towards the bottom and sides of the ventral valve; there are about four coils in each spiral cone; the primary stems of the spirals are attached to the hinge-plate of the dorsal valve; and after extending parallel to each other for a short distance, they bend at right-angles abruptly towards the lateral portions of the beak, and form two large curves facing the lateral portions of the valve; just before reaching their furthest extension in front they give off a semicircular band or loop, which is directed upwards towards the beak, and is exterior to the spiral cones on their dorsal side.

FAMILY SPIRIFERIDÆ.

Shell furnished internally with two calcareous spiral processes (apophyses) directed outwards towards the sides of the shell, and destined for the support of the oral arms, which must have been fixed immovably; the spiral lamellæ are sometimes spinulose, indicating the existence of rigid cirri, especially on the front of the whorls; valves articulated by teeth and sockets.

SPIRIFER, Sowerby, 1815.

Syn.—*Trigonotreta*, König, 1825. *Choristites*, Fischer, 1825. *Delthyris*, Dalman, 1828. *Fusula*, *Reticularia*, *Brachythyris*, M'Coy, 1844.

Distr.—300 sp. Lower Silurian—Trias; Arctic America—Chili, Falkland Islands, Europe, China, Thibet, Australia, Tasmania. In China these and other fossils are used as medicine. *S. striatus*, Mart. (cxxxvii, 95, 96). *S. Wolcottii*, Sowerby (cxxxvii, 97).

Shell transversely oval or elongated, trilobed, beaked, biconvex, with a dorsal ridge and ventral furrow; hinge-line wide and straight; area moderate, striated across; foramen angular, open in the young, afterwards progressively closed; ventral valve with prominent hinge-teeth, and a central muscular scar, consisting of the single adductor flanked by two cardinal impressions; dorsal valve with a small cardinal process, a divided hinge-plate, and two conical spires directed outwards and nearly filling the cavity of the shell; crura united by an oral loop. The shell and spires are sometimes silicified in limestone, and may be developed by means of acid. In *S. mosquensis* the dental plates are prolonged nearly to the front of the ventral valve.

SPIRIFERINA, d'Orbigny, 1847. (*Mentzelia*, Quenst., 1871.) Shell punctate, external surface spinulose; foramen covered by a pseudo-deltidium; interior of ventral valve with a prominent septum, rising from the adductor scar. 29 sp. Carb.—Lower Oolites; Britain, France, Germany, South America. *S. rostrata*, Schloth. (cxxxvii, 98–100).

CYRTIA, Dalman, 1828. Shell impunctate, pyramidal, beak prominent, area equiangular, deltidium with a small tubular foramen. Fossil, 10 sp. Silurian—Trias; Europe. *S. trapezoidalis*, Dalman (cxxxvii, 3).

MARTINIA, M'Coy, 1844. (Ambocœlia, Hall, 1860.) Dorsal margin shorter than the width of the shell, the angles of the hinge-margin shortly rounded; surface smooth; spiral lamellæ small. Silur.—Carb.; Eur., U. S. *S. glaber*, Sowb.

SUESSIA, Deslongchamps, 1855. (Dedicated to M. Suess.) Shell like Spirifer; texture fibrous; hinge-area wide as the shell; foramen deltoid; large valve with two cardinal septa, and a prominent central septum, supporting a little plate; small valve with a trilobed cardinal process, and a broad four-partite hinge-plate, with processes from the outer angles of the dental sockets; crura of the spires united by a transverse band supporting a small process. Fossil, 2 sp. Upper Lias; Normandy. *S. imbricata*, Desl. (cxxxvii, 1, 2).

SYRINGOTHYRIS, Winchell, 1863. Shell like that of Spirifer, with an elongated hinge-line. Ventral valve with a broad mesial sinus, a very broad area, and a narrow triangular fissure closed towards the apex by an external convex pseudo-deltidium; beneath which, and diverging from it, is another transverse plate connecting the vertical dental lamellæ, which are incurved so as to nearly join their inferior edges, thus forming a fissured tube, which projects beyond the limits of the plate from which it originates into the interior of the shell. A low median ridge extends from the beak to the anterior part of the valve. Dorsal valve depressed, without an area, and with a distinct mesial fold. Shell-structure punctate. Fossil, 2 sp. Carboniferous; United States, Ireland, Belgium. *S. typa*, Winchell (cxxxvii, 6). "Is it not an abnormal Spirifer or Cyrtia?"—MEEK.

CYRTINA, Davidson, 1858. (*Etym.*—Modified from the diminutive [*Cyrtidium*] of Cyrtia.) Shell resembling Spirifer, but without the vertical shelly plates which diverge from the extremity of the beak. Interior of ventral valve with two contiguous vertical septa, which coalesce into one median plate, which extends from the extremity of the beak to within a short distance of the frontal margin, and then diverges to form dental plates, as in Pentamerus. The fissure is covered by an arch-shaped deltidium; but in *C. Demarllii* the median septum is continued as far as the under surface of the deltidium, and the dental plates are fixed to the sides, instead of the upper edge, as in *C. heteroclita* and *C. septosa*. "Spiral coils having the same position as in Spirifer, but the first two coils are connected a little in front of the mid-length by an apparatus somewhat like that of Spirigera, but not so complicated. A very slender process springs upwards towards the central valve from each coil, and,

at a height of about one line, curves forward. The two then unite and form a single band, which extends forwards to about the front of the coil, and there ends in an obtuse point."—BILLINGS. 9 sp. Silurian, Devonian—Trias; Europe and North America. *S. heteroclita*, DeFrance cxxxvii, 4, 5.

MIMULUS, Barr. Shell like Spirifer, but the smaller valve with a sinus, the larger one with a saddle; interior unknown. *S. perversa*, Barr. Silurian; Bohemia.

ATHYRIS, M'Coy, 1844.

Etym.—*A*, without; *thuris*, a door (*i. e.* deltidium).

Syn.—Spirigera, d'Orbigny, 1847. Cleiothyris, King (not Phil.), 1850. Euthyris, Quenst., 1871. Actinoconchus, M'Coy, 1844.

Distr.—Fossil, about 100 sp. Silurian—Lias; N. and S. America and Europe. *A. lamellosa*, Lev. (cxxxvii, 7). *A. Roissyi* (cxxxvii, 8, 9).

Shell impunctate, transversely oval, or suborbicular, biconvex, smooth, or ornamented with squamose lines of growth, sometimes developed into wing-like expansions; hinge-line curved, area obsolete, foramen round, truncating the beak, deltidium obsolete; hinge-plate of dorsal valve with four muscular cavities, perforated by a small round foramen, and supporting a small complicated loop (?) between the spires; spires directed outwards, crura united by a prominent oral loop.

The foramen in the hinge-plate occupies the situation of the notch through which the intestine passes in the recent Rhynchonellæ; in *A. concentrica* a slender curved tube is sometimes attached to the foramen, beneath the hinge-plate. *A. tumida* has the hinge-plate merely grooved, and the byssal foramen is angular.

KAYSERIA, Davidson, 1882.

Etym.—Named after E. Kayser, a German palæontologist.

Distr.—*K. lens*, Phil. (cxxxvii, 10–12).

Distinguished from Athyris by its prominent dorsal septum and its connection with the loop, the shape and direction of the curved lamellæ composing the commencement of the loop, and the rounded process by which these lamellæ are continued, as well as the long extension of the accessory lamellæ.

The continuation of the accessory lamellæ from their commencement at the loop to the end of the spiral is especially notable. In Meristina there is a simple loop; in Whitfieldia this loop is continued by a bifurcation; this bifurcation is still further continued in Athyris; whilst in the species under consideration the lamellæ arising from the end of the loop are extended throughout the whole length of the spiral.

CHARIONELLA, Billings, 1861.

Syn.—Cryptonella, Hall, 1861.

Distr.—15 sp. Devonian; America, Spain. *C. scitula*, Hall.

Shell resembling *Athyris*, but more elongate-ovate or approaching to *Terebratula* in form. Internal spires as in *Athyris* and *Merista*, but the dorsal hinge-plate is either obsolete along the middle, or anchylosed to the bottom of the valve. Foramen terminal, bounded on the lower side by one or two deltidial pieces, or by a portion of the shell. The mesial septum in the dorsal valve is either absent or rudimentary.

NUCLEOSPIRA, Hall, 1859.

Etym.—*Nucleus*, and *spira*.

Distr.—7 sp. Silurian, Devonian; United States, England.

N. ventricosa, Hall (cxxxviii, 16–18).

Shell punctate; spheroidal; beaked; hinge-line shorter than the width of the shell; cardinal extremities rounded. Internal spires as in *Spirifera*. Ventral valve with a flattened space or false area beneath the beak, on each side of which, at the base, is a strong tooth; a narrow medio-longitudinal septum extends from the beak to the base. Dorsal valve furnished with a strong spatulate cardinal process, which, rising vertically from the cardinal margin, is closely grasped at its base by the cardinal teeth of the other valve; and thence bending abruptly upwards, and expanding, is projected into the cavity of the opposite beak, lying close upon the under side of the false area. Cardinal process grooved to allow of the passage of the peduncle, for the protrusion of which a minute foramen is sometimes observed in the beak. The crural processes originate at the base of the cardinal process. A medio-longitudinal septum as in the ventral valve.

Surface of shell apparently smooth, under a lens punctate; when perfect, covered with minute hair-like spines.

The larger species of this genus present some analogy in external appearance with *Spirigera*, and the presence of internal spires increases the similarity. The cardinal teeth resemble those of *Spirigera* and *Merista*. In form, and in the punctated test, it simulates *Magas*; while the elongate cardinal process of the dorsal valve resembles that structure in *Thecidium*.

MERISTA, Suess, 1851.

Syn.—*Camarium*, Hall, 1859.

Distr.—Silurian—Devonian; Europe, N. Am. *M. herculea*, Desl. (cxxxviii, 19).

Shell impunctate, dental plates and dorsal septum supported by arched plates ("shoe-lifter" processes, of King) which readily

detach, leaving cavities; spiral arms have been observed in all the species.

MERISTELLA, Hall, 1860. (Pentagonia, Cozzens? 1846. Gonioœlia, Hall, 1861.) Shell oval, ovoid, orbicular or transverse. Valves unequally convex, with or without a median fold and sinus; beak apparently imperforate, incurved; area none. Surface smooth or concentrically striated. Dorsal valve with a longitudinal septum; upper part of the ventral valve with a deep subtriangular muscular impression which unites with the rostral cavity. The species of this group are Meristæ without the peculiar appendage of the ventral valve. 17 sp. Silurian—Devonian; Europe, N. Am. *M. tumida*, Dalm. (cxxxviii, 20).

MERISTINA, Hall, 1867. Spirals of more simple character than in the typical group. *M. nitida*, Hall. Upper Silurian.

WHITFIELDIA, Davidson, 1881. End of loop bifurcated. Sil.; Europe, America. *M. tumida*, Dalm. (cxxxvii, 14).

BIFIDA, Davidson, 1882.

Dist.—2 sp. Devonian; Europe. *B. lepida*, Goldfuss (cxxxvii, 13).

Resembles Whitfieldia in the shape and position of the spirals and in the attachments to the hinge-plate, only the spirals of Bifida are slightly depressed or flattened on their dorsal side; there are usually four coils in each spiral; the loop is like that in Meristina, with the exception that it is placed nearer to the attachments to the hinge-plate, and that at the point where the two lamellæ composing the loop join there is a short bifurcation directed upwards, as in Whitfieldia.

RETZIA, King, 1850.

Etym.—Dedicated to the distinguished Swedish naturalist, Retzius.

Syn.—Trigeria, Bayle.

Dist.—Fossil, about 50 sp. Silurian—Trias; So. America, United States, Europe. *R. trigonella*, Schloth. (cxxxviii, 21–23).

Shell punctate, Terebratula-shaped; beak truncated by a round foramen, rendered complete by a distinct deltidium; hinge-area small, triangular, sharply defined; interior with diverging shelly spires.

Professor King first pointed out the existence of calcareous spires in several Terebratulæ of the older rocks, and others have been discovered by MM. Quenstedt, De Koninck, and Barrande. In form they resemble Terebratulina, Eudesia, and Lyra.

TREMATOSPIRA, Hall, 1859. (*Etym.*—*Trema*, a foramen, and *spira*.) Shell transverse, elliptical, or subrhomboidal, furnished with internal spires (arranged as in Spirifer); hinge-line shorter than the width of the shell. Valves articulated by teeth and sockets; beak of ventral valve produced or incurved and trur-

cated by a small round perforation separated from the hinge-line by a deltidium. A deep triangular pit or foramen beneath the beak, which is filled by the closely incurved beak of the dorsal valve. False areas sometimes defined. 7 sp. Upper Silurian—Middle Devonian; United States. *R. hirsuta*, Hall (cxxxviii, 24–27).

RHYNCHOSPIRA, Hall, 1859. (*Etym.*—*ρυχος*, a beak, and *spira*; in allusion to its similarity in form to Rhynchonella, and having internal spires.) Shell somewhat similar to Rhynchonella, but usually more symmetrically rounded, and with less distinct mesial sinuosities; and in these characters they resemble Waldheimia. Valves articulated by teeth and sockets, similar to those of Nucleospira; the crura supporting two conical spires. The cardinal process of the dorsal valve is a broad emarginate plate; beak of the ventral valve largely perforated. Surface plicated or striated. 7 sp. Silurian—Devonian; United States, Russia. *R. formosa*, Hall.

ACAMBONA, White, 1862.

Syn.—Eumetria, Hall, 1864.

Distr.—*A. prima*, White (cxxxviii, 30). Carb.; U. S.

Shell resembling Retzia externally, furnished with internal spires, pointing outward and downward? beak of ventral valve prominent, incurved, pointed; area emarginate in front, or V-shaped, reaching to the point of the beak, and extending forward of the beak of the dorsal valve on each side of it; beak of dorsal valve closely incurved, filling or nearly filling the forked space or emargination in the front part of the area, being itself without angular winged extensions or area, to meet that of the opposite valve; shell-structure punctate.

Differs from Retzia in having a pointed ventral beak, curved hinge-line, and no angular cardinal wings on the dorsal valve; from Uncites in having an area and punctate structure; from Trematospira in its pointed ventral beak and true area.

DAYIA, Davidson, 1881.

Distr.—*D. navicula*, Sowb. (cxxxviii, 28, 29). Silurian; England.

Oval, broadest posteriorly; ventral valve very convex, keeled along the middle, beak closely incurved, dorsal valve slightly convex posteriorly, anterior half of shell concave, surface smooth; in the interior of the dorsal valve a slightly raised ridge extends from under the hinge-plate to about half the length of the valve, and on either side are the two adductor scars; the sockets are widely separate; primary stems of the spirals extend parallel to each other for a short distance, bend at right-angles abruptly towards the lateral portions of the beak,

and form two large curves facing the lateral portions of the valve; on approaching the front they form four or five convolutions, which become smaller to the terminal coil, which faces the middle of the lateral portions of the shell; near the front the primary lamellæ give off two processes which converge and extend between the spiral coils in an upward and backward direction; after becoming united towards the middle of the shell, they are again prolonged in the shape of a single lamella, which proceeds upwards for a little distance with its extremity directed towards the hinge-plate. In the interior of the ventral valve a mesial groove extends to about the middle of the shell, and on either side, running parallel with the hinge-line, are two broad, rounded projections, at the outer extremity of which is situated the articulating tooth; below these are the elevated muscular scars.

HINDELLA, Davidson, 1882.

Distr.—*H. umbonella*, Billings (cxxxvii, 15). Palæozoic; Anticosti.

Shell elongate ovate; spiral cones with their apices directed towards the lateral margins of the shell; about six coils in each spiral; two principal stems of the spiral cones attached to the hinge-plate, and after extending a little way into the interior of the shell between the spirals, suddenly bent backwards towards the hinge; they then form a broad, rounded curve, facing the bottom of the dorsal valve, the curve being very gentle, so that the two primary lamellæ on the dorsal side seem almost like parallel lines; when the primary lamellæ reach the front they give off a semicircular band or loop having a projection or spike-like process at the top of it; this loop is directed upwards towards the beak, and is almost immediately behind the two primary lamellæ on the dorsal side of the spirals; the loop is therefore internal to the spirals.

UNCITES, DeFrance, 1826.

Distr.—Fossil. Devonian; Europe. *U. gryphus*, Schloth. (cxxxviii, 31, 32).

Shell impunctate; oval, biconvex, with a long incurved beak; foramen apical, closed at an early age; deltidium large, concave; spiral processes directed outwards; no hinge-area.

The large, concave deltidium of *Uncites* so much resembles the channel formed by the dental plates of *Pentamerus*, that Dalman mistook the shell for a member of that genus. The discovery of internal spires, by Professor Beyrich, shows that it only differs from *Retzia* in being impunctate and destitute of hinge-area. Some of the specimens have corresponding depressions in the sides of the valves, forming pouches which do not communicate with the interior.

FAMILY KONINCKINIDÆ.

Shell small, concavo-convex; hinge-margin straight or curved, without area; no foramen; spiral lamellæ with their apices directed towards the large valve.

KONINCKINA, Suess, 1853.

Distr.—Triassic; U. S. *K. Leonhardi*, Wissm. (cxxxviii, 33–36).

Shell orbicular, concavo-convex, smooth; valves articulated? closely appressed; ventral valve convex, dorsal concave; beak incurved, no hinge-area nor foramen; interior of each valve furrowed by two spiral lines of four volutions, directed inwards, and crossing the vascular impressions; umbo with three diverging ridges. The small spiral cavities, once occupied by the arms, and now filled with spar, may be seen in specimens with both valves, by holding them to the light. M. Suess, of Vienna, states that he has found traces of very slender spiral lamellæ occupying the furrows.

ANOLOTHECA, Sandberger, 1856.

Distr.—Devonian; Europe. *A. venusta*, Schnur.

Shell fibrous, concavo-convex, without foramen, area or deltidium; hinge-margin curved; large valve convex, with two teeth and a median septum which is anteriorly cleft, and on either side of which are the muscular impressions; smaller valve not so deep, with cleft hinge-process, and close to it the lamellæ, to which the spirals were attached.

THECOSPIRA, Zugmayer, 1880.

Distr.—Rhætian. *T. Haidingeri*, Suess.

Shell like Thecidium, but with spirals within, similar to those of Koninckina, the axes diverging towards the large valve, the bases roof-like over the small valve.

FAMILY STROPHOMENIDÆ.

Shell transversely oblong, depressed, rarely foraminated; hinge-line wide and straight; beaks inconspicuous; valves plano-convex, or concavo-convex, each with a hinge-area notched in the centre; ventral valve with prominent teeth; muscular impressions occupying a saucer-shaped cavity with a raised margin; adductor central; cardinal and pedicel impressions conjoined, lateral, fan-like; dorsal valve with a tooth-like cardinal process between two curved brachial processes; adductor impression quadruple; vascular impressions consisting of six principal

trunks in the dorsal valve, two in the ventral, the external branches turned outwards and backwards, inclosing wide ovarian spaces. Indications have been observed, in several genera, of horizontally coiled spiral arms; the space between the valves is often very small. The shell-structure is punctate, except in a few instances, where the original texture is probably obliterated.

ORTHIS, Dalman, 1827.

Etym.—*Orthos*, straight.

Syn.—*Orthambonites*, Pander, 1830. *Schizophoria*, King, 1850.

Distr.—Fossil, 300 sp. Lower Silurian—Carb.; Arctic Am., United States, South America, Falkland Islands, Europe, Thibet. *O. striatula*, Schloth. (cxxxviii, 37–39).

Shell transversely oblong, radiately striated or plaited, biconvex, hinge-line narrower than the shell, cardinal process simple. brachial processes tooth-like, prominent and curved.

BILOBITES, Linn., 1775. (*Dicælosia*, King, 1850.) Ventral margin deeply cut out in the middle, forming two lobes in each valve; two strong curved crural processes from the hinge-margin of the smaller valve. Silurian; Gotland and U. S. *O. biloba*, Linn.

PLATYSTROPHIA, King, 1850. Shell somewhat transverse, nearly equivalve, with a long, straight hinge-line; both valves very convex, radially ribbed, with an area and trigonal deltidial opening; beaks curved, approaching; large valve with a deep median sinus. Silurian, Carboniferous. *O. lynx*, Eichw. (cxxxviii, 40).

ENTELETES, Fischer, 1830. (*Choristites*, Fischer [part], 1825.) Like *Platystrophia*, but the hinge-margin short; surface coarsely wrinkled, and finely radially sculptured. *O. Lamarcki*, Fischer. Carboniferous; Russia.

MYSTROPHORA, Kayser, 1871. Shell like *Orthis*, but the small valve with a very high median septum, which reaches to the other valve, and so divides the closed shell into two chambers; the two tooth-plates are united to the septum. Silurian, Devonian. *O. Lewisii*, Davids. Davidson makes this a synonym of *Skenidium*, Hall.

STREPTORHYNCHUS, King, 1850.

Etym.—*Strepto*, I bend or twist; *rhynchos*, a beak.

Syn.—*Hipparionix*, Vanuxem, 1842. *Orthotetes* (Evans), Fisch. (part), 1829.

Distr.—6 sp. Sil.—Perm.; Europe, Asia, America, and Australia. *S. Devonica*, d'Orb.

Shell inequivalved, convex or concavo-convex, externally striated; hinge-line rather shorter than the width of the shell; dorsal valve semicircular, with a small narrow area. Ventral

valve with a prolonged and oftentimes bent beak; area triangular, with a fissure covered by a convex pseudo-deltidium. No foramen is observable, but the cardinal process is at times seen partially extending under the deltidium.

Interior of ventral valve, with a strong hinge-work on either side at the base of the fissure, supported by a dental plate; muscular scars two, elongated, oval, deeply excavated, separated by a wide mesial ridge.

Interior of dorsal valve with a largely developed cardinal process, composed of two projections, grooved or bidentated towards the extremity of their outer surface; socket-plates large, and partly united to the lower portion of the cardinal process; adductor scars quadruple, occupying more than a third of the length of the valve, and arranged in pairs, divided by a short rounded mesial ridge.

This genus is intermediate between *Orthis* and *Strophomena*.
MEEKELLA, White and St. John, 1870. Ventral valve without septum, with two broad dental lamellæ which are continuous from the cardinal teeth to the beak, passing directly in front of the sutures between the cardinal area and the pseudo-deltidium, and thence slightly diverging, they extend forward along the bottom of the valve about half-way to the front, the anterior margins of the lamellæ arching backward and upward to the dental processes; in the rear of the hinge-line are three chambers, not communicating together, but all opening into the shell. Dorsal valve with long cardinal process, curving backward in front of the pseudo-deltidium, which has a wing-like expansion on each side of it, curved up at its outer edge to form the elongated dental fosset for the reception of the process of the opposite valve. Muscular markings unknown: outer surface apparently punctate. Carboniferous; U. S. *S. striatocostatus*, Cox.

ORTHISINA, d'Orb., 1847.

Syn.—*Klitambonites* (part), *Pronites*, *Hemipronites*, *Gonambonites*, Pander, 1830.

Distr.—Fossil. Lower Silurian; Europe. *O. anomala*, Schloth. (cxxxviii, 41, 42).

Shell impunctate? widest at the hinge-line; cardinal notch closed, byssal notch (fissure) covered by a convex pseudo-deltidium, sometimes perforated by a small round foramen.

SKENIDIUM, Hall, 1861. (*Etym.*—*Skenidion*, a little tent.) Shell having the general aspect of *Orthis*, except in the extreme elevation of the ventral valve; cardinal process prolonged into a median septum, which extends to the base or front margin of the shell, and occasionally bifurcates at this lower extremity. Area large and triangular in the typical species. 3 sp. Silur.; United States. *O. insignis*, Hall.

TROPIDOLEPTUS, Hall, 1859.

Etym.—*Tropis*, a keel, and *leptos*, thin; the carinated ventral valve and shallow visceral cavity, in its analogy with *Leptæna*.

Distr.—2 sp. Silurian; United States. *Strophomena carinata*, Conrad (cxxxviii, 43, 44).

Shell transversely oval, or longitudinally semielliptical, articulating by teeth and sockets, hinge-line about equal to the breadth of the shell. Ventral valve convex, with a linear area and triangular foramen in the margin of the area; from the inner edges of this proceed the dental lamellæ, which are separated from the area by a narrow groove strongly crenulated on the outer edge, and extending obliquely outwards, terminating in a low ridge which partially surrounds the muscular impression; dorsal valve concave; cardinal process prominent, wedge-shaped, supporting the bases of the crura; dental fossets crenulated, surface plicated; shell-structure punctated.

VITULINA, Hall, 1861.

Etym.—*Vitula*, a goddess.

Distr.—Devonian; New York. *V. pustulosa*, Hall (cxxxviii, 45–48).

Shell resembles that of *Tropidoleptus*, but the dental processes are not crenulated, nor distinctly separated from the area as in that genus.

STROPHOMENA, Rafinesque, 1827.

Etym.—*Strophos*, bent; *mene*, crescent.

Syn.—*Peridiolithus*, Hüpsch, 1768. *Brachyprion*, Shaler, 1869. *Leptæna*, Dalman, 1828.

Distr.—Fossil, 129 sp. Lower Silurian—Carb.; N. America, Europe, Thibet. *S. alternata*, Conr. (cxxxviii, 49, 50).

Shell semicircular, widest at the hinge-line, concavo-convex, depressed, radiately striated; area double; ventral valve with an angular notch, progressively covered by a convex pseudo-deltidium; umbo depressed, rarely (?) perforated, in young shells, by a minute foramen; muscular depressions four, central pair narrow, formed by the adductor; external pair fan-like, left by the cardinal and pedicel-muscles; dorsal valve with a bilobed cardinal process, between the dental sockets, and four depressions for the adductor muscles.

There are no apparent brachial processes in the dorsal valve of *Strophomena*, and it is possible that the spiral arms may have been supported at some point near the centre of the shell as in *Productus*; *S. rhomboidalis* occasionally exhibits traces of spiral arms, in the ventral valve. *S. latissima*, Bouch., has plain areas, like *Calceola*.

The valves of the *Strophomenas* are nearly flat until they

approach their full growth, they then bend abruptly to one side; the dorsal valve becomes concave in *S. alternata* and *rhomboidalis*, whilst in *S. planumbona* and *euglypha* it becomes convex; these distinctions are not even subgeneric.

STROPHODONTA, Hall, 1850. Shell with a denticulated hinge-line. Silur.; N. Am. *S. prisca*, Hall.

LEPTÆNA, Dalman, 1827, emend. Davidson. (Plectambonites, Pander [part], 1830. Leptænulopsis, Haupt.) Valves regularly curved; dorsal concave, thickened, muscular impressions elongated. Fossil, 41 sp. Lower Silurian—Lias; N. Am. and Eur. The Lias Leptænas resemble Thecidia internally; they are free shells, with sometimes a minute foramen at the apex of the triangular deltidium. *S. transversalis*, Dalm. (cxxxviii, 53; cxxxix, 54, 55).

LEPTAGONIA, M'Coy, 1844. (Plectambonites, Pander [part], 1830. Leptæna, King, 1846. Strophomena, Meek, 1873.) Silurian—Carboniferous. *S. rhomboidalis*, Dalm. (cxxxviii, 51, 52).

DAVIDSONIA, Bouchard, 1849.

Etym.—Dedicated to the author of the Monograph of British Fossil Brachiopoda.

Distr.—Fossil, 3 sp. Devonian. *D. Verneuli*, Bouchard (cxxxix, 56, 57). Devonian; Eifel.

Shell solid, attached by outer surface of the ventral valve to rocks, shells, and corals; valves plain, articulated; ventral valve with a wide area; foramen angular, covered by a convex deltidium; disk occupied by two conical elevations, obscurely grooved by a spiral furrow of 5–6 volutions; dorsal valve with two shallow lateral cavities; vascular impressions consisting of two principal submarginal trunks, in each valve, with diverging branches; cardinal and adductor impressions distinct. The furrowed cones undoubtedly indicate the existence of spiral arms, similar to those of *Atrypa*, but destitute of calcified supports. The upper valve sometimes exhibits markings derived from the surface on which the shell has grown. The mantle-lobes seem to have continued depositing shell until the internal cavity was reduced to the smallest possible limit.

AMPHICLINA, Laube, 1865.

Etym.—*Amphi*, about, and *clino*, a slope.

Distr.—2 sp. Triassic; St. Cassian, Austria. *A. dubia*, Münster.

Shell inequivalve, circular, excavated, smooth; ventral valve convex, beak short; perforated; dorsal concave; hinge-line very short and suboblique; area wanting; deltidium triangular, distinct; structure of the test fibrous, squamose; externally

Amphiclina resembles some Leptænæ, the shell-structure is very similar.

PORAMBONITES, Pander, 1830.

Syn.—Isorhynchus, King, 1849.

Distr.—8 sp. Lower Silurian; Russia and Portugal. *P. æquirostris*, Schloth. (cxxxix, 58).

Shell impunctate; surface minutely pitted; each valve with a minute hinge-area and indications of two septa; foramen angular, usually concealed.

SYNTRIELASMA, Meek and Worthen, 1865.

Distr.—Carboniferous; N. and S. America. *S. hemiplicatus*, Hall (cxxxix, 59, 60).

Shell thin, gibbous or subglobose, in adult specimens; valves articulated by teeth and sockets; hinge-line straight and very short; area small, partly common to both valves, but higher in the ventral valve, where it is divided by a triangular, open foramen; beaks incurved, subequal; surface radiately plicate, and striate, the middle plication of the dorsal valve larger, with corresponding sinus of the other valve; socket-plates of the dorsal valve much as in *Orthis*, being quite prominent and very diverging, with a linear, longitudinal, mesial ridge between them; dental laminae of the ventral valve thin, prominent, very closely approximate at their connection with the bottom of the valve, and with a similar mesial septum, extending as three nearly parallel plates to the middle of the valve; muscular and visceral impressions unknown; shell-structure distinctly punctate.

FAMILY PRODUCTIDÆ.

Shell concavo-convex, with a straight hinge-line; valves rarely articulated by teeth; closely appressed, furnished with tubular spines; ventral valve convex; dorsal concave; internal surface dotted with conspicuous, funnel-shaped punctures; dorsal valve with a prominent cardinal process; brachial processes (?) sub-central; vascular markings lateral, broad, and simple; adductor impressions dendritic, separated by a narrow central ridge; ventral valve with a slightly notched hinge-line; adductor scar central, near the umbo; cardinal impressions lateral, striated.

PRODUCTUS, Sowerby, 1814.

Syn.—Protonia, Link, 1830. *Arbusculites*, Murray, 1831.

Distr.—Fossil, 81 sp. Devonian—Permian; N. and S. Am., Europe, Spitzbergen, Thibet, Australia. *P. giganteus*, Sowb. (cxxxix, 61, 62). *P. horridus*, Sowb. (cxxxix, 63–65).

Shell free, auriculate, beak large and rounded; spines scat-

tered; hinge-area in each valve linear, indistinct; no hinge-teeth; cardinal process lobed, striated; vascular impressions simple, curved; ventral valve deep, with two rounded or subspiral cavities in front. These shells may have been attached by a pedicel when young, the impressions of the pedicel-muscle blending with those of the hinge-muscles in the ventral valve. A few species appear to have been permanently fixed. *P. striatus* is irregular in its growth, elongated and tapering towards the beak, and occurs in numbers packed closely together. *P. proboscideus* seems to have lived habitually in cavities, or half-buried in mud, as suggested by M. d'Orbigny; its ventral valve is prolonged several inches beyond the other, and has its edges rolled together and united, forming a large permanently open tube for the brachial currents. The large spines are most usually situated on the ears of the ventral valve, and may have served to moor the shell; being tubular they were permanently susceptible of growth and repair. Although edentulous, the dorsal valve must have turned on its long hinge-line with as much precision as in those genera which are regularly articulated by teeth.

PRODUCTELLA, Hall, 1867. Like *Productus*, but hinge-margin with teeth; both valves with area, the larger one with deltidial opening; kidney-shaped impressions very broad. *P. subaculeata*. Murch. Devon.

STROPHALOSIA, King, 1844.

Syn.—Orthothrix, Geinitz, 1848. Leptænalosia, King, 1845.

Distr.—Fossil, 8 sp. Devonian—Carb.; Europe, Himalaya (Gerard). *S. excavata*, Geinitz (cxxxix, 66).

Shell attached by the umbo of the ventral valve; subquadrate; covered with long slender spines; valves articulated, dorsal moderately concave, ventral convex, each with a small area; fissure covered; vascular impressions conjoined, reniform.

AULOSTEGES, Heltersen, 1847. Shell like *Productus*; ventral valve with a large, flat, triangular hinge-area with a narrow convex pseudo-deltidium in the centre; beak a little distorted, as if attached when young; dorsal valve slightly convex near the umbo; interior as in *Productus*. *S. Wangenheimii*, Vern. (cxxxix, 67, 68). Permian; Russia.

CHONETES, Fischer, 1837.

Etym.—*Chone*, a cup.

Distr.—Fossil, 47 sp. Silurian—Carboniferous; Europe, North America, Falkland Islands. *C. striatella*, Dalm. (cxxxix, 69–71).

Shell transversely oblong, with a wide and straight hinge-line; area double; valves radiately striated, articulated; hinge-margin of ventral valve with a series of tubular spines; fissure covered; interior punctate-striate; vascular impressions very small.—DAVIDSON.

? AULACORHYNCHUS, Dittmar, 1872.

Distr.—*A. concentrica*, Sem. Carb.; Russia.

Shell thin, broad, concavo-convex, with straight hinge-margin; beak of the large valve strongly curved; no area or deltidium; hinge toothless; muscular impressions small, not well marked; surface leafy, without spines; large valve with a long, two-parted lamella, three-parted at the end, commencing at the beak and only united by the lateral margins with the shell.

[CALCEOLA, Lamarek, 1809.

This is a genus of Cœlenterata.]

ORDER LYOPOMATA.

(Pleuropygia, Bronn. Inarticulata, Huxley.)

Arms free, unsupported by shelly apophyses; intestine opening by a lateral anus (Tretenterata, King); borders of the mantle lobes entirely disunited; brachia without a distinct median lobe. Shell in most cases without hinge-teeth, articulation or cardinal process.

FAMILY CRANIIDÆ.

Shell orbicular, calcareous, hingeless; attached by the umbo, or whole breadth of the ventral valve, rarely free; dorsal valve limpet-like; interior of each valve with a broad granulated border; disk with four large muscular impressions, and digitated vascular impressions; structure punctate.

Animal with free spiral arms, directed towards the concavity of the dorsal valve, and supported by a nose-like prominence in the middle of the lower valve; mantle extending to the edges of the valves, and closely adhering; its margins plain.

CRANIA, Retzius, 1781.

Etym.—*Kraneia*, capitate.

Syn.—*Criopus*, Poli, 1791. *Orbicula*, Cuvier, 1798. *Orbicularius*, Dumeril, 1806. *Chonionora*, Schauroth, 1854.

Distr.—5 sp. Spitzberger Britain, Mediterranean, India, New South Wales; 150 fath as. Fossil, 37 sp. Lower Silurian—; Europe.

Shell smooth or radiately striated; umbo of dorsal valve subcentral; of ventral valve subcentral, marginal, or prominent and cap-like, with an obscure triangular area traversed by a central line.

The large muscular impressions of the attached valve are sometimes convex, in other species deeply excavated; those of the upper valve are usually convex.

C. Ignabergensis is equivalve, and either quite free or very slightly attached. *C. anomala*, Müll. (cxxxix, 72-75), is gregarious on rocks and stones in deep water, both in the North Sea and Mediterranean; the animal is orange-colored, and its labial arms are thick, fringed with cirri, and disposed in a few horizontal gyrations.

PSEUDOCRANIA, M'Coy, 1859. (Pholidops, Hall, 1860. Paleocrania, Eichw., 1871.) Is free and has the internal border of the valves smooth; the branchial impressions blend in front. *C. antiquissima*, Eichw.

CRANISCUS, Dall, 1871. (Siphonaria, Quenst., non Sowb.) Fixed valve divided by a transverse and a longitudinal median septum into three cells, the posterior of which contains the muscular impression and the rostellum. *C. velata*, Quenst. (cxxxix, 76, 77).

ANCISTROCRANIA, Dall, 1877. (Cranopsis, Dall, non Adams, 1871.) Shell attached, upper valve with two slender pointed apophyses divaricating from the internal apex of the upper valve. *C. Parisiensis*, DeFrance (cxxxix, 78-80.) Cretaceous.

SPONDYLOBOLUS, M'Coy, 1852. (Spondylobus, Davidson, 1853.) Suborbicular, slightly narrowed towards the short, indistinct hinge-line; nearly equivalve, flattened; hæmal valve with a slightly excentric apex, beneath which, on the interior the substance of the valve is thickened into a wide undefined boss; opposite valve slightly longer, from the apex being perfectly margined and somewhat produced; channeled by a narrow triangular groove, the anterior end of which is flanked within by two very prominent thick conical shelly bosses, representing hinge-teeth; valves thick, testaceous, not glossy, minutely fibrous. *C. craniolaris*, M'Coy. L. Silurian; Ireland.

FAMILY TRIMERELLIDÆ.

Usually massive; umbo of the large valve often large, pointed, solid or hollow, its hinge-face with a well-developed area, and large deltidium, solid throughout; hinge of both valves rudely or faintly dentary; that of the pedicel-valve thick, entire, somewhat elevated, sometimes supported by an upright rib, with a wide median space enclosing a lozenge-shaped scar; that of the brachial valve with a more or less elevated median prominence, or depression; attached to the interior surface of the posterior half of both valves is an elevated platform, solid, or doubly vaulted; from the middle of its anterior end a median plate occasionally projects into the anterior half of the valve, especially the brachial one; both valves have a profound impression or crescent running a little within the margins of their posterior half, including the hinge; a submarginal impression or archlet characterizes the anterior half of the valves.

MONOMERELLA, Billings, 1871.

Distr.—Upper Silurian; Canada, Europe. *M. prisca*, Billings (exxxix, 81, 82).

Shell thick, circular or transversely oval; large valve with projecting umbo, double-chambered; area and deltidium large; hinge generally thick and elevated, ledge-shaped, depressed in the middle; cardinal facet a wall-like space rising out of or behind the ledge of the hinge; cardinal buttress strong, lamelliform; platform flat; slightly elevated; widest, highest and very obtusely angulated in front; in the brachial valve the platform is trilobed, usually with a thin margin.

DINOBOULUS, Hall, 1871.

Syn.—Rhynobolus, Hall (part), 1871. Obolellina, Billings (part), 1871. Conrardia, Hall, 1874.

Distr.—Upper Silurian; N. Am., Europe. *D. Davidsoni*, Salter. *D. Conradi*, Hall (cxi, 83, 84).

Shell circular, or transversely oval, moderately thick; pedicel-valve with slightly prominent umbo; area wider than long; platform more or less sinuated; widely V-shaped and slightly raised in front; crescent prominently marked in its crown and sides; hinge moderately thick, with a rounded edge on which, and in front of the cardinal facet, is a pair of scars; brachial valve rather tumid at the umbo, somewhat strongly trilobed, outer margins a little raised, antemedian portion rounded, projecting, and terminating in a slightly developed median plate; crescent a strongly marked linear scar on the hinge, arching forward in front of the cardinal facet, inner border of its sides with strongly marked indentations, outer border a fine line; a rather strongly marked subcardinal scar in the umbonal cavity; a large rhomboidal postmedian scar in front of the latter.

TRIMERELLA, Billings, 1862.

Syn.—Rhynobolus, Hall (part), 1871. Obolellina, Billings (part), 1871. ? Gotlandia, Dall, 1871.

Distr.—7 sp. Silurian; Canada, U. S. *T. Lindstromi*, Dalm. (cxi, 85-87).

Valves thick, longitudinally oval; umbo of pedicel-valve usually massive, solid, occasionally double-chambered, irregularly projecting; area of considerable size, longer than wide; deltidium large; hinge generally thick and elevated, rudely or slightly dentary, and variously modified in different species; cardinal facet large; crescent rather well-defined in typical species; platforms elevated, and doubly vaulted, occasionally solid and slightly raised; median plate occurring generally in both valves, largest in the brachial one.

? CHELODES, Davidson, King, 1874.

Distr.—U. Silurian; Gotland, Sweden. *C. Bergmari*, D. and King.

Notwithstanding remarkable points of resemblance, it is our opinion that it is not a palliobranch; on the contrary, we are strongly inclined to the belief that it belongs to a section of the cœlenterates, represented by *Calceola* and *Gonicphyllum*.—DAVIDSON AND KING.

Possibly a coral. Looks like the internal fulcrum of *Zirphæa* (*Leuconyx*, H. Adams).—DALL.

LINGULOPS, Hall, 1871.

Distr.—L. Silur.; N. Am. *L. Whitfieldi*, Hall.

Founded upon a cast of the interior of a single valve of a Lingula-shaped shell, but differing from that genus in its interior impressions. The most striking features are: first, a posterior, semicircular, broad zone, with an inner sinused border; second, an arched fillet situated below the hinge and on the zone, the crescent characterizing the Trimerellids; third, a central space marked with scars (the apophysary system); fourth, linear impressions occurring in the anterior half of the fossil median plate, and pair of primary vessels belonging to the brachiocœle.

FAMILY DISCINIDÆ.

Shell attached by a pedicel, passing through a foramen in the ventral valve; valves not articulated; minutely punctate.

Animal with a highly vascular mantle, fringed with long, horny setæ; oral arms curved backwards, returning upon themselves, and ending in small spires directed downwards, towards the ventral valve.

DISCINA, Lamarck, 1819.

Syn.—Orbicula, Sby. (not Cuvier), 1830. *Schizotreta*, Kutorga, 1848.

Distr.—10 sp. West Africa, W. Indies, Malacca, Peru and Panama. Fossil, 64 sp. Silurian—; Europe, United States, Falkland Islands. *D. striata*, Schum.

Shell orbicular, horny; upper valve limpet-like, smooth or concentrically lamellose, apex behind the centre; lower valve flat or conical, with a sunk and perforated disk on the posterior side, from which interiorly extends a furrow; interior polished.

Animal transparent; mantle-lobes distinct all round; labial folds united, not extensile; alimentary canal simple, bent upon itself ventrally, and terminating between the mantle-lobes on the right side. There are four distinct adductor muscles, as in Crania; and three pair of adjuster muscles for keeping the

valves opposed to each other. Some of these are probably inserted in the pedicel. The oral cirri are extremely tender and flexible, contrasting with the stiff and brittle setæ of the mantle, which are themselves setose like the bristles of certain annelides (*e. g.*, the sea-mouse, Aphrodite). The relation of the animal to the perforate and imperforate valves is shown to be the same as in Terebratula by the labial fringe; but the only process which can possibly have afforded support to the oral arms is developed from the centre of the ventral valve, as in Crania. Baron Ryckholt has represented a Devonian fossil from Belgium, with a fringed border; but if this shell is the *Crania obsoleta*, of Goldfuss, the fringe must belong to the shell, and not to the mantle.

In some species the valves are equally convex, and the foramen occupies the end of a narrow groove.

ORBICULOIDEA, d'Orb., 1847. (Schizotreta, Kutorga, 1848.) Perforation at the posterior, instead of the anterior, end of the internal furrow, which last is impressed from the outside, instead of from the inside, as in Discina. *D. elliptica*, Kutorga.

DISCINISCA, Dall, 1871. Lower valve more or less flattened, concave or compressed, upper valve more convex; apices of both subcentral or subposterior; lower valve with a small septum, as in Discina, behind which is a disk or area impressed from the outside, and traversed by a longitudinal fissure in the median line of the valve; shell more or less horny in texture, minutely tubulous. Silurian—Recent. *D. lamellosa*, Brod. (exl, 88–93).

PATERULA, Barrande.

Syn.—Cyclus, Barr.

Distr.—*P. Bohemica*, Barr. Silur.; Bohemia.

FAMILY OBOLIDÆ.

Shell somewhat inequivalve, rounded or oblique, calcareo-corneous; hinge-margin thickened, and grooved for the passage of the peduncle; posterior adductor scars more or less distant from the median line.

OBOLUS, Eichwald, 1829.

Etym.—*Obolus*, a small Greek coin.

Syn.—Ungulites, Ungula, Pander, 1830. Aulonotreta, Kutorga, 1848.

Distr.—Fossil, 8 sp. Lower and Upper Silurian; Sweden, Russia, England, United States. *O. Davidsoni*, Salter (exl, 94, 95).

Shell orbicular, calcareo-corneous, depressed, subequivalve, smooth; hinge-margin thickened inside, and slightly grooved

in the ventral valve; posterior adductor impressions separate; anterior pair subcentral; impressions of adjusters lateral.

OBOLELLA, Billings, 1861.

Eym.—Diminutive of *Obolus*.

Syn.—? *Keyserlingia*, Pander, 1861.

Distr.—12 sp. Cambrian, Lower Silurian; United States, Canada, England, Spain. *O. chromatica*, Billings (exl, 99, 100).

"Shell ovate, circular or subquadrate, convex or plano-convex; ventral valve with a false area, which is sometimes minute, and usually grooved for the passage of the peduncle; dorsal valve either with or without an area; muscular scars in the ventral valve four; one pair in front of the beak near the middle, or in the upper half of the shell, and others situated one on each side near the cardinal edge; shell calcareous; surface concentrically striated, sometimes with thin, extended, lamellose edges.

"In general form these small shells somewhat resemble *Obolus*, but the arrangement of the muscular impressions is different. In *Obolus* the two central scars have their smaller extremities directed downwards, converging towards each other; but in this genus the arrangement is exactly the reverse."—**BILLINGS**.

KUTORGINA, Billings, 1861. Hinge-line straight, nearly as wide as the shell, sides nearly straight, meeting the cardinal border at an obtuse angle; neural valve with an area and foramen; a pair of subcentral, oval muscular impressions, but no vestiges of lateral scars; externally radiately striate. Cambrian; Canada. *O. cingulata*, Billings (exl, 1, 2).

MONOBOLINA, Salter, 1865. Shell resembling *Obolus*; broad, external surface radiately striated; muscular scars united closely along the central line. Silur.; England. *O. plumbea*, Salter.

SCHMIDTIA, Volborth, 1869.

Syn.—*Dicellomus*, Hall? 1871.

Distr.—Silur.; Devon.; Russia, N. America.

Shell very small, long-oval, shining; large valve swollen, with pointed beak, and grooved area; within two deep muscular impressions; in the small valve a raised ledge between the impressions.

LEPTOBOLUS, Hall, 1871.

Distr.—3 sp. Silurian; N. America. *L. lepis*, Hall (exl, 3, 4).

Shell small, thin, swollen, oval; large valve with a short beak, and deeply, broadly grooved area; within a two-parted, somewhat raised muscle-plate; small valve slightly thickened dorsally with an internal, three-parted, diverging, muscular sson.

? *ACRITIS*, Volborth, 1869.

Distr.—Silur.; Russia. *A. sculpta*, Kutorga.

ACROTHELE, Linnarson, 1876.

Distr.—Cambrian; Eur., N. America. *A. coriacea*, Linnarson.

Shell horny, consisting of layers, of which the outer one is rough, the inner one smooth and shining; ventral shell depressed-conical, with perforated apex; from the apex to the hinder margin the surface is flattened; small valve with a curved marginal apex arising from two wart-like projections; within having two long, diverging muscular impressions in front of the hinge-margin, and two small, round ones in the middle, with a median ridge between them.

? *IPHIDEA*, Billings, 1874.

Distr.—3 sp. Cambrian; Canada, Newfoundland, Sweden. *I. bella*, Billings.

Resembles *Acrotreta*, but differs in having a large, convex deltidium.

TREMATIS, Sharpe, 1847.

Syn.—*Orbicella*, d'Orbigny, 1847.

Distr.—Fossil, 14 sp. Lower and Upper Silurian; North America and Europe. *T. terminalis*, Emmons (cxl, 96–98).

Valves convex, superficially punctate; dorsal valve with a thickened hinge-margin (and three diverging plates, indicated on casts.—SHARPE).

SCHIZOCRANIA, Hall and Whitfield, 1875.

Distr.—L. Silurian; Ohio. *S. filosa*, Hall (cxl, 5).

Shell inequivalve, rounded; lower valve attached, posteriorly with a deep, triangular sinus, reaching almost to the middle of the valve; upper valve convex with posterior beak and six internal muscular impressions.

SIPHONOTRETA, Verneuil, 1842.

Etym.—*Siphon*, a tube; *tretos*, perforated.

Syn.—? *Mesotreta*, Kutorga, 1848.

Distr.—Fossil, 9 sp. Lower and Upper Silurian; Britain, Bohemia, Russia. *S. verrucosa*, Vern. (cxl, 6–8).

Shell oval, biconvex, slightly beaked, conspicuously punctate, or spiny; beak perforated by a tubular foramen; hinge-margins thickened; ventral valve with four close adductor scars surrounding the foramen. The spines are tubular, and open into the interior of the shell by prominent orifices.—CARPENTER. *S. anglica*, Morris, has moniliform spines.

ACROTRETA, Kutorga, 1848. \

Distr.—3 sp. Cambrian, Lower Silurian; Russia, England, Sweden. *A. subconica*, Kutorga (exl, 9, 10).

Shell triangular; large valve bullet-shaped, with a high area and toothless hinge-margin; end of the beak with round perforation; surface not spiny.

?VOLBORTHIA, Möller, 1874.

Distr.—*V. recurva*, Kutorga. Silurian; Russia.

HELMERSENIA, Pander, 1861.

Distr.—Lower Silurian; Russia.

Shell nearly equivalve, rounded, small, horny-cretaceous; lower valve with slightly produced beak, perforated, area narrow, grooved; upper valve with thickened hinge-margin; muscular impressions as in *Obolus*.

FAMILY LINGULIDÆ.

Shell oblong or orbicular, subequivalve, attached by a pedicel passing out between the valves; texture horny, minutely tubular.

Animal with a highly vascular mantle, fringed with horny setæ; oral arms thick, fleshy, spiral, the spires directed inwards, towards each other.

LINGULA, Bruguière, 1789.

Etyim.—*Lingula*, a little tongue.

Syn.—Pharetra, Bolten, 1798. Glossina, Phill, 1848.

Distr.—16 sp. India, Philippines, Moluccas, Australia, Feejees, Sandwich Islands, West America, North Carolina. Fossil, 140 sp. Lower Silurian—; North America, Europe, Thibet *L. anatina*, Lam. (exl, 11–13). *L. Murphiana*, King (exl, 14).

Shell oblong, compressed, horny, greenish, slightly gaping at each end, truncated in front, rather pointed at the umbones; dorsal valve rather shorter, with a thickened hinge-margin, and a raised central ridge inside.

Animal with the mantle-lobes firmly adhering to the shell, and united to the epidermis, their margins distinct, and fringed all round; branchial veins giving off numerous free, elongated, narrow loops from their inner surfaces; visceral cavity occupying the posterior half of the shell, and surrounded by a strong muscular sheath; pedicel elongated, thick; stomach long and straight, sustained by inflections of the visceral sheath; intestine convoluted dorsally, terminating between the mantle-lobes on the right side, oral arms disposed in about six close whorls, their cavities opening into the prolongation of the visceral sheath in front of the adductors.

Lingulæ existed in the British seas as late as the period of the Coralline Crag. The recent species have been found at small depths, and even at low-water half buried in sand. *L. Davisii*, Lower Silurian, Tremadoc, has a pedicel-groove like *Obolus*.

GLOTTIDIA, Dall, 1870. Shell with two diverging internal laminae in the neural valve proceeding from the beak, and a mesial septum in the hæmal valve; otherwise like *Lingula*. 6 recent sp. E. and W. coasts of North America. *L. albida*, Dall. California.

LINGULELLA, Salter, 1866. (*Etym.*—Diminutive of *Lingula*.) "Shell nearly equivalve, broad, oblong, the ventral valve pointed, with a distinct pedicel-groove. Muscular scars strong, nearly as in *Obolus*, but the pair of anterior retractors are more linear than in *Obolus*, and the sliding muscles small, and not quite external as in *Obolus*."—SALTER. 3 sp. Cambrian, Lower Silurian; Ireland, Wales, Norway. *L. Davisii*, M'Coy.

LINGULEPIS, Hall, 1863. (*Etym.*—*Lingula*, a little tongue; *lepis*, a scale.) Shell thin, subovate, or subtrigonal; composition and structure as in *Lingula*. Ventral or larger valve with beak more or less produced and pointed; visceral scar trilobed, with a longitudinal raised mesial line or septum—lateral divisions diverging, and usually longer than the middle one; dorsal or smaller valve with the beak less produced than that of the other; visceral scar flabelliform. 4 sp. Cambrian; America. *L. piniformis*, Owen.

DIGNOMIA, Hall, 1873. With strong internal median septum, otherwise as in *Lingula*. Silurian—Devonian; U. S. *L. alveata*, Hall.

A P P E N D I X.

ADDITIONS AND CORRECTIONS.

VOL. I.

Geographical Distribution of the Mollusca.

Mr. Thomas Bland, of New York, who is so well acquainted with the distribution of the land shells of the West Indies, has kindly sent me the following notes and corrections:

[P. 180.] *Helix similaris*, Fer., has been found in Barbados only, of the West India Islands; an accidental introduction, no doubt, as coffee is not cultivated there. It is not found in Jamaica, Hayti or Porto Rico, in all of which coffee is cultivated.

[P. 198.] *Peruvian Region*. The occurrence of *Cyane* (Prosperpinacea) is remarkable.

[P. 201.] *Caribbean Region*. In the faunal grouping of the islands Turk's Islands should go with the (1) Bahamas; and with (4) Hayti and Navassa, the important island of Gonave, in which there are 21 species—9 peculiar.

The Virgin Islands and St. Barts are to be added to the fifth group: but south of a line drawn to the north of Saba and Barbuda, the fauna changes remarkably. South of that line *Macroceramus* and *Strophia* disappear; *Cylindrella* is represented by two or three species only. Important operculate genera also are absent, *Tudora*, *Cistula*, etc.

Group 7. Barbados is peculiar; the *Cyclostomæ* not represented; *Streptaxis* found there (as well as in Trinidad), and also *Bulimus* (*Borus*) *oblongus*.

Group 8. Windward Islands, Curaçao and Buen Ayre. The islands from and including Guadeloupe to Grenada are called the Windward Islands; Trinidad and Tobago should go together as a separate group; and again, as another group, Aruba. Curaçao and Buen Ayre.

The grouping somewhat corresponds with the depth of the surrounding water; with some curious exceptions: between St. Thomas and St. Croix the depth is 1570 fathoms; nearly 1000 fathoms between Martinique and St. Lucia; between St. Vincent and Barbados, 1493 fathoms.

Bahamas and Turk's Is. [p. 201]. The number of species

now known is 77; about 40 peculiar. Three of the operculates are found also in Cuba.

Jamaica, *Stoastoma*, has two extra-limited species, one in Hayti, and one in Porto Rico.

Hayti. Gonave has 21 species, of which 8 are operculates. There are two peculiar species of *Cylindrella*, and curiously, a form of *Helix sagemon*, of Cuba.

The gradual diminution of genera easterly is curious: *Megalomastoma* disappears; there is a fossil *impression* of *Strophia* in Sombrero, and a fossil species in St. Croix. *Strophia*, *Macroceramus*, *Megalomastoma*, *Tudora*, *Cistula*, are absent in the Lesser Antilles; there is one *Macroceramus* on the Anguilla Bank. *Cyclophorus* is represented in the West Indies only in the Lesser Antilles.

Table of Sedimentary Deposits [p. 224].

Strike out from Pliocene the Sumter Period, and insert in Miocene (Eastern U. S.):

Carolinian (Sumter), so as to stand opposite Sarmatian [p. 225].

[P. 225.] Instead of Yorktown Period, put

{ Virginian,
{ (Yorktown,) { Marylandian, so as to stand opposite Mediterranean Stages, etc.

[P. 226.] (R. h. column, at bottom), instead of "Panfield," read "Punfield."

[P. 227.] Jurassic (r. h. column), after "Great Oolite" insert "Dogger."

[P. 229.] (R. h. column, at top), instead of "Ludovian," read "Ludlovian."

Classification [p. 252].

Macdonald (Jour. Linn. Soc., xv, 161, 255) discusses the value of some of the characters employed in the classification of the Mollusca, pointing out the existence of several analogous genera, and analogous subdivisions of the Heteropoda and Pulmonata. He proposes the following system for the gastropods:—

Division I. Monœcia.

Subdivision I. Lingual dentition typically pavimental.

Order 1. Pneumonophora.

Suborder 1. Pulmonata.

A. Terrestrial; B. Aquatic; C. Estuary or Marine.

Order 2. Apneumonophora.

Suborder 1. Nudibranchiata.

A. Cryptobranchiata (Phylliroë, Elysia, Limapontia, etc.).

B. Phanerobranchiata (Eolis, Doris, Tritonia, Phyllidia, etc.).

Suborder 2. Tectibranchiata (Pleurobranchus, Aplysia, Bulla, Tornatella, etc.).

Subdivision II. Lingual membrane strap- or ribbon-like, rhachis and pleura distinctly differentiated, dental processes recurved (Anclodonta).

Order 1. Heteroglossa (Gray).

Suborder 1. Polyplacophora (Chiton, Chitonellus).

Suborder 2. Cyclobranchia (Patella, Patina).

Suborder 3. Cervicobranchia (Tectura, Gadinia, Lepeta).

Suborder 4. Cirrobranchia (Dentalium).

Order 2. Rhachidoglossa (Gray).

Suborder 5. Dieranobranchia. Gills two, symmetrical on the back of the neck (Scutus, Doridobranchus, Emarginula, Puncturella, Fissurella).

Suborder 6. Schismatobranchia. Gills in two plumes on the left side of the gill cavity (Teinotis, Padollus, Haliotis, Scissurella).

Suborder 7. Scutibranchia. Gills in a spiral line on the left side (Stomatella, Trochus, Turbo, Rotella, Nerita, Neritina, Navicella).

Suborder 8. Pseudobranchia. No distinct gills (Helicina, Proserpina, Ceres). [Nearly all of the groups of subdivision II of "Monœcia," are known to be diœcious.—G. W. T., Jr.]

Division II. Diœcia.

Subdivision I. Lingual membrane unarmed, or with pleural teeth only.

Order 1 (without name).

A. Rhachis and pleuræ unarmed (Pyramidellidæ, Cancellariidæ). [Cancellaria has an armed radula.]

B. Pleural teeth simple [Toxoglossa, Troschel] (Pleurotomidæ, Acusidæ, Conidæ).

C. Dentition, Pavimental [Ptenoglossa, Troschel] (Solariidæ, Scalariidæ, Ianthinidæ).

Subdivision II. Lingual membrane strap- or ribbon-like.

Order 1. Proboscifera.

Suborder 1. Orthodonta. Dental processes pointing directly backwards [Rhachiglossa, Troschel].

A. Lingual dentition uniserial (Volutidæ [See suborder II]).

B. Lingual dentition triserial.

a. Rhachis and pleuræ comb-like.

Dental processes numerous, small.

Strap short (Mitridæ). Strap long. Teeth short (Fasciolaridæ). Teeth long (Fusidæ).

Dental processes few and large (Turbinellidæ).

b. Pleuræ uncinatæ.

Uncinus with an additional internal cusp (Buccinidæ).

Uncinus simple, rhachis armed.

Cusps, large, few (Muricidæ, Olividæ, Harpidæ).

Cusps small, numerous (Turritidæ).

Uncinus foliated, rhachis unarmed (Columbellidæ).

Suborder 2. Anactodonta [Tænioglossa, Troschel]. Cusps recurved from the fore-part of the plates (Volutidæ, Naticidæ, Tritonidæ, Ranellidæ, Doliidæ, Cassididæ, Strombidæ).

Order 2. Rostrifera.

Suborder 1. Orthodonta (Heteropoda and Phoridæ).

Suborder 2. Anaciodonta [Tænioglossa, Troschel].

A. Marine or littoral (Cypræidæ, Vermetidæ, Calyptraeidæ, Planaxidæ, Littorinidæ, Cerithiidæ, Rissoidæ, Truncatellidæ).

B. Aquatic (Melaniidæ, Paludinidæ, Valvatidæ).

C. Terrestrial (Cyclophoridæ, Cyclostomidæ, Diplommatinidæ).

Herman v. Jhering's classification of the mollusca, published in the "Jahrbücher der Deutschen Malakozologischen Gesellschaft," iii, 1876, and "Vergleichende Anatomie des Nervensystemes und Phylogenie der Mollusken," 1877, has not met with general acceptance; the only novelty in most of his groups being the new names. In the few real changes made he is singularly unhappy, the characters being in disaccord with others generally recognized as of much greater importance. Dr. Paul Fischer thus concludes a careful review of von Jhering's works: "He has endeavored to introduce into the classification certain characters afforded by the nervous system. He is premature in this, for what we know of the nervous system is absolutely insufficient. For the rest, his classification is only a combination of characters derived from the branchiæ and dentition. It is worth neither more nor less than those of Mörch, Gray, Gill, Adams, etc., and I do not find in it a trace of real progress; only the names of the fundamental divisions have been changed. Is this the last word of the new anatomical school?"—FISCHER, "Sur la nouvelle classification des Mollusques de M. von Jhering," Journal de Zoologie, vi, Paris, 1877.

The late Dr. Troschel (Archiv für Naturgeschichte, 1876) speaks quite as plainly as to the demerits of this classification, and takes the opportunity to disclaim any intention, by his own studies of the dentition of the mollusca, to advocate the exclusive use of the characters afforded by the lingual organ in classification. This veteran conchological anatomist modestly

refers to his life-work as "a contribution towards the knowledge of a single character among the many that must be taken into account in making a natural classification."

Several other recent attempts to classify the mollusca upon single or partial characters are equally or more incongruous; and were therefore omitted from my chapter on classification.

On Collecting and Arranging Shells [p. 290].

The new liquid glues sold by stationers, such as "Royal," "Chase's," "Lepage's," etc., are highly recommended for attaching specimens to the cardboard labels. They have a great advantage in being always ready for use, but do not possess sufficient *body* to fix heavy specimens in every position desired; this deficiency may be supplied by the use of yellow wax, which may be moulded to any shape required, and then attached with the glue both to the cardboard and specimen.

[VOL. II.]

CEPHALOPODA.

[P. 46.] 5th line from bottom, instead of "liassic," read "jurassic."

ACANTHOTEUTHIS, Wagner [p. 48].

PIRAGMOTEUTHIS, Mojsisovics, 1882. Triassic; Europe. *A. bisinuatus*, Bronn.

ORTHOCERAS, Breyn [p. 51].

5th line from bottom, instead of "L. Silurian," read "Cambrian."

ENDOCERAS, Hall; CAMEROCERAS and DIPLOCERAS, Conrad.

The two groups, Endoceras and Cameroceras, appear to be very closely allied, if not identical forms; the latter being founded upon a species (*C. Trentonensis*) possessing an inner sheath or tube which is permanently attached to the septa in precisely the same manner as that of Endoceras, and differing simply in its lateral position, beaded form, and more gradual expansion; the tube of Endoceras, moreover, is not always central. Its expansion is more rapid, when it occurs; there are also occasionally additional and apparently free tubes within the first or permanent tube of Endoceras, which do not occur in Cameroceras.

Diploceras appears to have possessed an inner tube of large size, surrounded by septa and an outer tube, the inner tube being near one side of the outer one; it also is probably identical with Endoceras.—WHITFIELD, *Geol. Wisconsin*, iv, 228.

RHYNCHORTHOCERAS, Remelé, 1881. (*Ancistroceras*, Boll [part], 1857.) *O. Breynii*, Boll. L. Silur.; Germany.

LITUITES, Breyn [p. 56].

Add to synonymy *Ancistroceras*, Boll (part), 1857.

NAUTILUS, Breyn [p. 60].

SOLENOCHILUS, Meek and Worthen, 1870. Proposed instead of *Cryptoceras*, d'Orb, 1850, not of Barrande, 1846 (changed to *Ascoceras*), nor *Cryptoceras*, Latreille (Hymenoptera), 1804. A carboniferous species, *Nautilus (Solenochilus) collectus*, M. and W., is described from Indiana.

PLEURONAUTILUS, Mojsisovics, 1882. Triassic; Europe.

AMMONITES, Brug. [p. 60].

Mojsisovics has characterized the following new Ammonite genera in "Cephalopoden der Mediterranean Triasprovinz," 1882:—

DINARITES, KLIPSTEINIA (*Ceratitæ*).

CELTITES (*Tropitæ*).

PROCLADISCITES (*Arcestæ*).

BENECKEIA, LONGOBARDITES, LECANITES, NANNITES, GYMNITES, STURIA (*Pinacocera*).

PETALICHNUS, TERATICHNUS, TRACHOMATICHNUS, S. A. Miller, Jour. Cin. Soc. ii, 1880.

SÆRICHNITES, Billings, Cat. Sil. Foss. Antic, 1866.

Are names given to supposed tracks of cephalopods.

GASTROPODA.

PROSOBRANCHIATA [p. 103].

Carelessness and habit have caused the retention of the old order Scutibranchiata, notwithstanding the loss of its principal distinctive characters. The position and development of the branchiæ vary, usually according to the form of the shell, and these no longer afford satisfactory characters; although in the Scutibranchiata the branchiæ are more usually a pair, whilst in the Pectinibranchiata one leaf is more or less abortive. The scutibranchiates were formerly supposed to be androgynous, but the sexes are now known to be separated, although the want of a penis in the male prevents them from being externally distinguishable. The shells of the first suborder of scutibranchiates, the Podopthalmæ, are not separable from the holostomate pectinibranchs, such as *Natica*, although in general the pectinibranchs are siphonostomate, the scutibranchs holostomate; in the second suborder, Edriopthalma, the conical, non-spiral shells form a good conchological character.

For the first suborder (with the addition of the Fissurellidæ

from the second) Prof. Gill uses the name *Rhipidoglossa*, characterized by the development of numerous hooklets or uncini upon either side of the central and few lateral teeth of the lingual ribbon (vol. i. Pl. xii, f. 43-50). But this character is not coextensive with the order Scutibranchiata, although nearly so, and is besides of doubtful importance. Rather than use it in combination with a modification of the extent and characters of the Scutibranchiata, I prefer to suppress that order entirely, as Fischer has done, and as I originally intended to do (vol. i, p. 82).

In the case of *Helicina*, which possesses the dentition and form of shell of the scutibranchs, there is an external sexual organ in the male, thus allying it with typical pectinibranchs. This and the other land mollusks provided with opercula, and in which the branchiæ are represented by a network spread upon the walls of a pulmonary chamber, are by some systematists made a separate order, *Pneumonopoma*, connecting the pectinibranchs with the Pulmonata; they are closely connected through *Ampullaria*, etc., as well as by their opercula and bisexuality, with the former.

The second suborder of scutibranchs, the *Edriopthalmæ*, are distinguished from ordinary pectinibranchs by their conical shell, but vary greatly among themselves in dentition (the *Patellidæ*, etc., being docoglossate (vol. i, Pl. xii, f. 51), and in the form and position of the branchiæ (vol. ii, 326, 329, 330, 331, 332).

The limits of the order Pectinibranchiata should be enlarged to include the non-spiral shells and variously situated gills of the limpets, and the aberrant, pneumonopomous, operculated terrestrial mollusks.

I annex Fischer's classification :

Class Gastropoda.

Subclass Univalvia.

Androgyna.

Order 1. Pulmonata.

Order 2. Opisthobranchiata.

Dioica.

Order 3. Nucleobranchiata (Heteropoda).

Order 4. Prosobranchiata (Platypoda).

Subclass Multivalvia.

Order 5. Polyplacophora.

COLUMBELLA, Lam. [p. 178].

MITROLUMNA, Bucq., Dautz. et Dollf., 1883. Proposed for a group of shells uniting the characters of *Mitra* and *Columbella*: no operculum. Type, *Columbella Greci*, Phil. Mediterranean.

PLEUROTOMA, Lam. [p. 183].

TERES, Bucq., Dautz. et Dollf., 1883. Shell small, columella straight and thin, lip thin, spire and aperture both long. *Pl. anceps*, Eichw. Intended to include a number of small forms heretofore classed with Drillia.

BELLARDIA, Bucq., Dautz. et Dollf., 1883. Shell small, lanceolate, with sutural sinus, lip and columella thin; oblique ribbed and coronate. *P. gracile*, Mont. Europe.

(Mangilia.)

MANGILIELLA, Bucq., Dautz. et Dollf., 1883. Shell more lanceolate than Mangilia, more fusiform, with oblique ribs. Intermediate between Mangilia and Raphitoma. *M. multilineata*, Desh. Mediterranean.

(Bela.)

HÆDROPLEURA, Monterosato, 1883. Shell operculate, not turriculated, strongly ribbed. *B. septangulare*, Mont. Mediterranean. (Bela is restricted to the boreal turriculated species, of light texture.)

DONOVANIA, Bucq., Dautz. et Dollf., 1883. Instead of Lachesis, Risso, 1826, preoccupied by Daudin, 1804 (Reptiles), and Savigny (Arachnids). Nesæa, Risso, which is synonymous with Lachesis, is also preoccupied by Lamarek (Polypes) and Leach (Crustaceans).

CASSIS, Lam. [p. 200].

Brugnonia pulchella, Jeffreys, is perhaps the fry of *Cassis sulcosa*.—Ann. Mag. N. Hist., xii, 67, 1883.

NATICA, Lam. [p. 204].

PAYRAUDEAUTIA, Bucq., Dautz. et Dollf., 1883. Characterized by three umbilical grooves, the subcentral one large, separated by two plications. Operculum corneous. *N. intricata*, Donovan. Mediterranean.

SCÆVOGYRA, Whitfield, 1877.

Distr.—3 sp. Fossil. L. Magn. Limestone; Wisconsin. *S. Swezyei*, Whitfield.

Shell thin, sinistral, spire more or less elevated, of rounded volutions; umbilicus broad, open; peristome entire, uniting with the preceding volution on the inner side, and more or less spreading or trumpet-shaped externally. Appears to be related to the family Naticidæ.

LYOSOMA, White, 1883.

Distr.—2 sp. Jurassic; Utah. *L. phaseolaris*, White.

Shell resembling certain forms of Neritina and Nerita in

general aspect; volutions few, the last one much expanded; outer lip moderately thin; inner lip moderately thickened and apparently without any callus; the portion of the body, exclusive of the last volution, very small and without a proper columella. Family relations doubtful, but they are probably with the Velutinidæ. [See p. 294, vol. ii.]

TURRITELLA, Lam. [p. 224].

SMITHIA, Maltzan, 1883. Like *Eglisia*, but the whorls not in contact, with revolving striæ; peristome simple. Operculum corneous, multispiral. *S. gracilis*, Maltzan. Isl. Gorée.

Littorinidæ [p. 240].

IPHITUS, Jeffreys, 1883.

Etym.—One of the Argonauts.

Type.—*I. tuberatus*, Jeffreys. Europe.

Shell conical, covered with spiral rows of tubercles; the apex consists of a cylindrical process of several whorls, which is closely striated lengthwise; operculum horny, paucispiral with a lateral nucleus.

The peculiar apex may be compared to the styliform process of *Ianthina* and *Stylifer*, and there are several other genera, such as *Cæcum* and *Turritella*, in which the embryonic spire, which had become useless for the occupancy of the mollusk, is decolated or plugged up.

RISSEA, Frem. [p. 264].

HEMISTOMIA, Crosse. Mr. E. Marie, who collected this mollusk in New Caledonia, writes to me that it is fluviatile; it should therefore be removed to the subfamily *Hydrobiinæ*.

DIPLOMMATINA, Benson [p. 282].

One species occurs in the island of Trinidad, West Indies.

Helicinidæ [p. 290].

The dentition (which is really rhipidoglossate) is erroneously described from H. and A. Adams' "Genera." The figure referred to, however, correctly represents it. The family has been usually included under the old order *Scutibranchiata*.

ORDER SCUTIBRANCHIATA [p. 293].

This order (and its suborders) may be suppressed. See p. 348.

VELATES, Montf. [p. 298].

VELATELLA (Meek, 1872), White, 1883. Shell resembling both *Dostia* and *Velates*, suboval, flattened beneath, depressed-convex

above, with a minute submarginal apex; inner lip large, flattened or slightly convex, the margin smooth or crenulate; outer lip usually a little thickened and sometimes crenulate within, and more or less continuous with the inner lip; aperture comparatively small; surface smooth or radiately ribbed; usually polished. Differs from *Dostia* in its more nearly perfect bilateral symmetry and minute apex; from *Velates* in its marginal apex. 4 sp. Cretaceous and Laramie; U. S.

CYCLOSTREMA, Marryat [p. 299].

THARSIS, Jeffreys, 1883. (*Etym.*—One of the many synonyms of *Cyprus*.) Shell globular, solid and glossy; peristome circular and continuous, but attached to the pillar on that side; base closed by a pad or thick testaceous layer in the adult, perforated in the young; operculum chitinous or horny, and multispiral. This genus differs from *Cyclostrema* in the peristome being, although continuous, not free or detached from the rest of the shell, and in the umbilicus being closed instead of open in the adult. Type, *T. Romettensis*, Seguenza. Mediterranean.

GANESA, Jeffreys, 1883. (*Etym.*—The Hindoo god of science.) Shell shaped like a *Natica*, thin; peristome continuous, free and separate in the young, but united to the periphery in the adult; spire having an oblique axis; base perforated, not umbilicate; operculum horny, multispiral. Differs from *Tharsis* in the obliquity of the spire and the perforation of the base at every stage of growth. 2 sp. Europe. *G. pruinosa*, Jeffreys.

Fissurellidæ [p. 326].

? DIRINUS, M'Coy, 1844.

Distr.—*D. Bucklandi*, M'Coy. Carboniferous; Ireland.

Patelliform; apex perforated by two oval foramina, symmetrically placed one on the right side, the other on the left.

A very problematical fossil.

CYLICHNA, Lovén [p. 359].

CRYPTAXIS, Jeffreys, 1883. Shell small, white, glossy, sometimes with fine revolving striae; spire deeply sunken, and for the most part concealed in a small cavity in the centre of the crown, but showing the apex and sometimes one or two whorls at the bottom of the cavity. 4 sp. Deep-sea; Europe. *C. crebripunctatus*, Jeffreys. Intermediate between *Cylichna* and *Utriculus*.

RHODOPE, Kölliker [p. 391].

This is not a mollusk, but a peculiarly aberrant Turbellarian. —*Science*, i, 433.

VOL. III.

PELECYPODA.

Cyprinidæ [p. 187].

ROUDAIRIA, Munier-Chalmas.

Syn.—Trigonocardia, Zittel.*Distr.*—Cretaceous; N. Africa, India. *R. Druï*, Mun.-Chal. (cxv, 49-51).

Shell trigonal or trapezoidal, thick, convex; beaks prominent, incurved, anterior, with a deep lunule under them; posteriorly a sharp keel, behind which the surface is smooth, the rest of the shell being folded; hinge-margin thick; the right valve with three cardinal teeth, the posterior one separated from the central by a deep pit, and divided, the anterior tooth horizontal, there is a strong posterior lateral tooth; in the left valve the posterior cardinal is small, the middle one very large, the anterior divided, its branches diverging, posterior lateral tooth strong; anterior muscular impression upon a raised base; ligament external.

PTYCHODESMA [p. 269].

Fourth line of description, for "*Planorbis*," read "*Pectunculus*."

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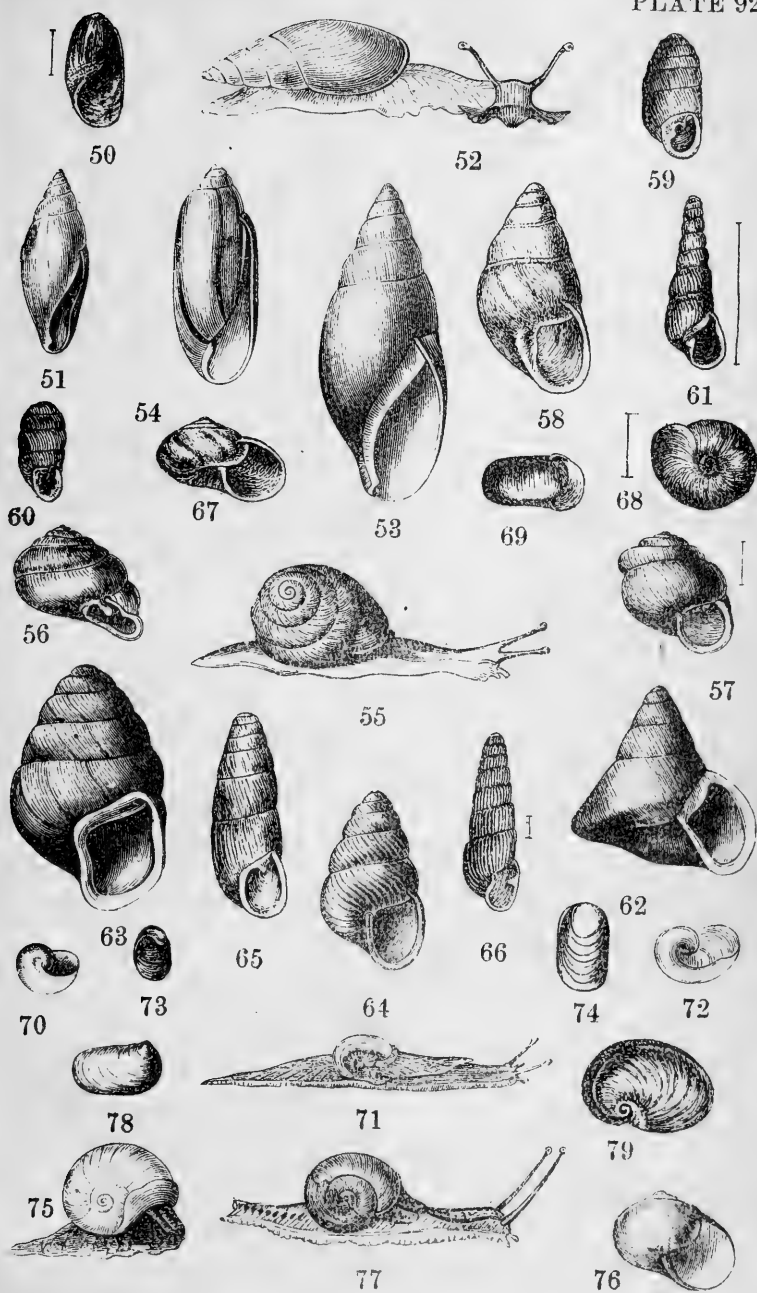
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- 11-13. *Lingula anatina*, Lam. Moluccas. 11, dorsal; 12, ventral; 13, ventral. In fig. 11 a small portion of the liver and visceral sheath have been removed, to show the course of the stomach and intestine. In some specimens the whole of the viscera; except a portion of the liver, are concealed by the ovaries. In fig. 13 the front half of the ventral mantle-lobe is raised, to show the spiral arms; the black spot in the centre is the mouth, with its upper and lower lips, one fringed, the other plain. The mantle-fringe has been omitted in figs. 11, 13. *a a*, anterior adductors; *a'*, posterior adductor; *p p*, external adjusters; *p' p'*, central adjusters; *r r*, anterior retractors (the anterior occlusors of Hancock); *r' r' r'*, posterior adjusters; *c*, capsule of pedicle; *n n*, visceral sheath; *o*, œsophagus; *s*, stomach; *l*, liver; *i*, intestine; *v*, vent; *b*, branchial vessels; *m'*, mantle-margin; *m*, inner lamina of mantle-margin retracted, showing bases of setæ; *s*, setæ. . 341
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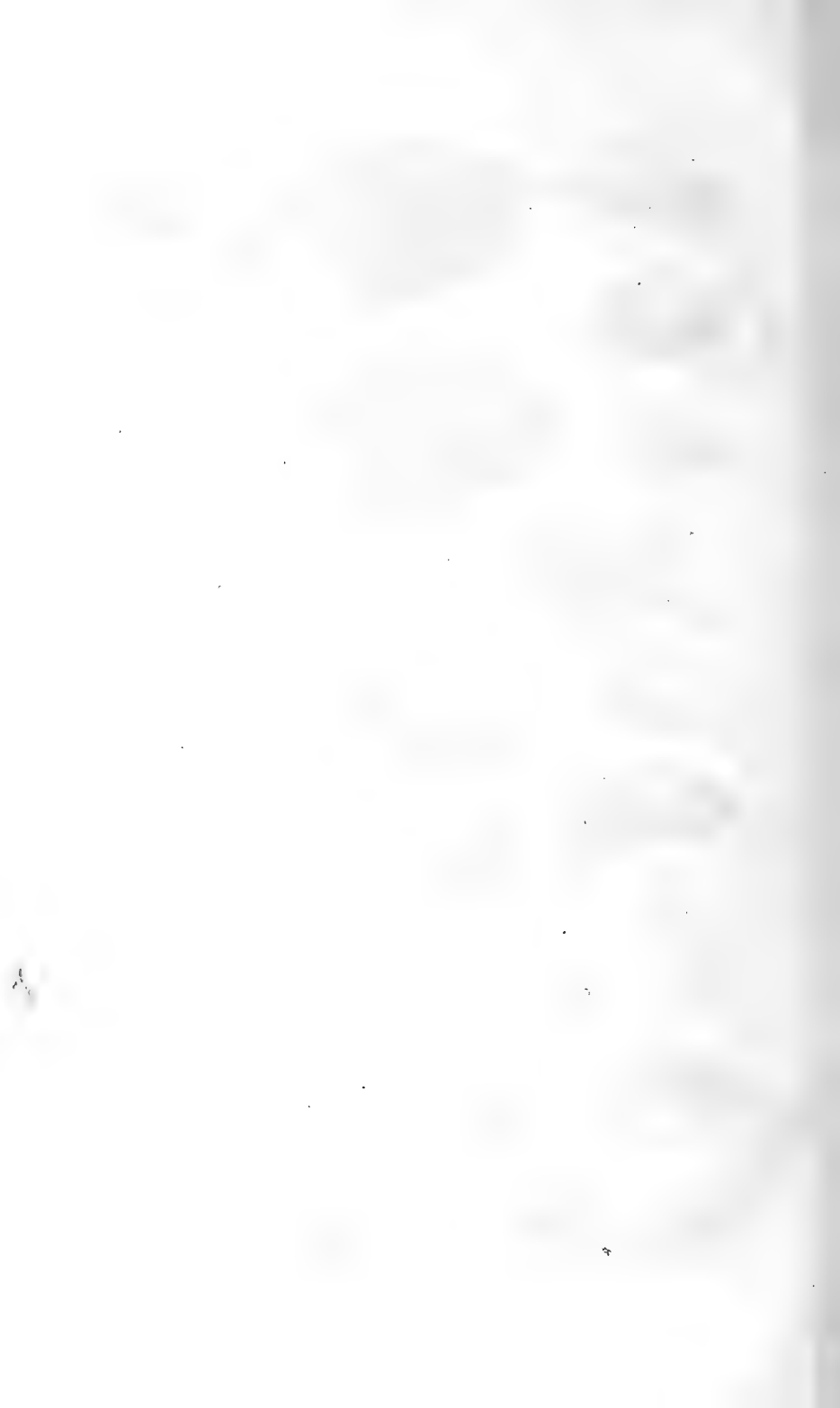
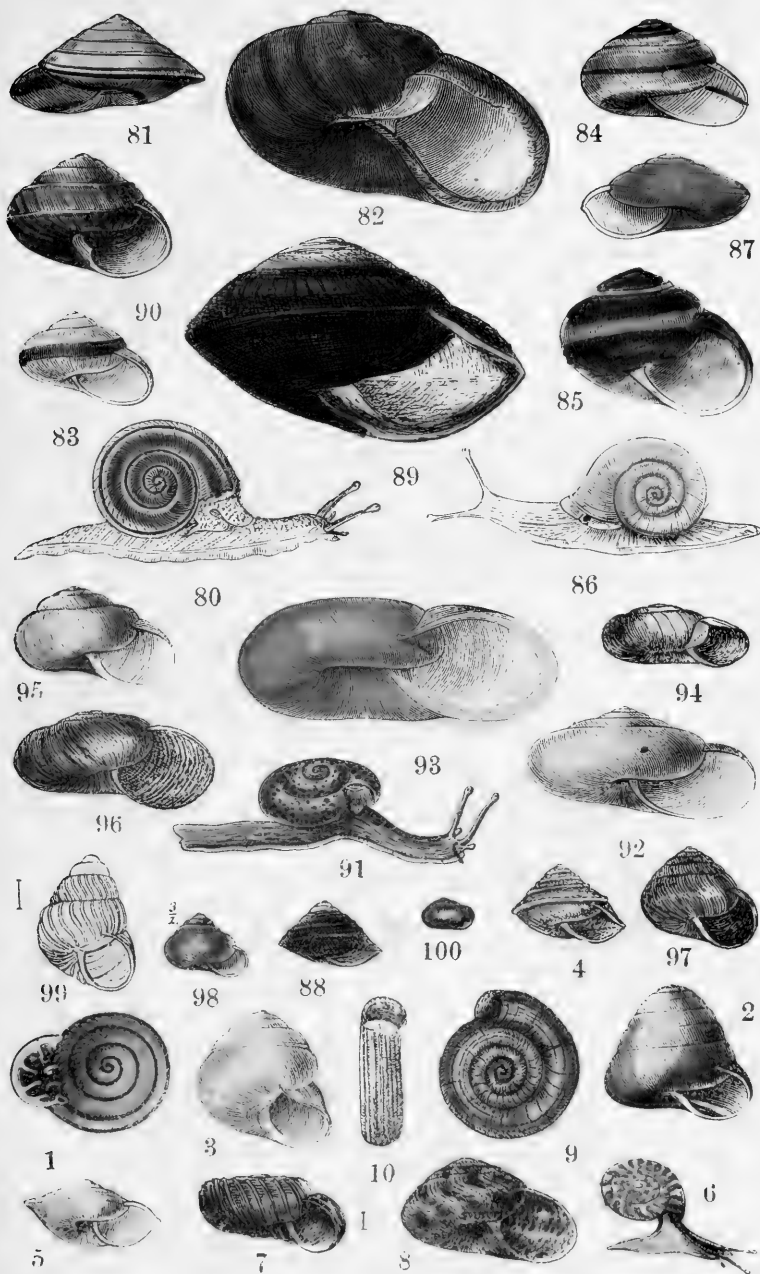
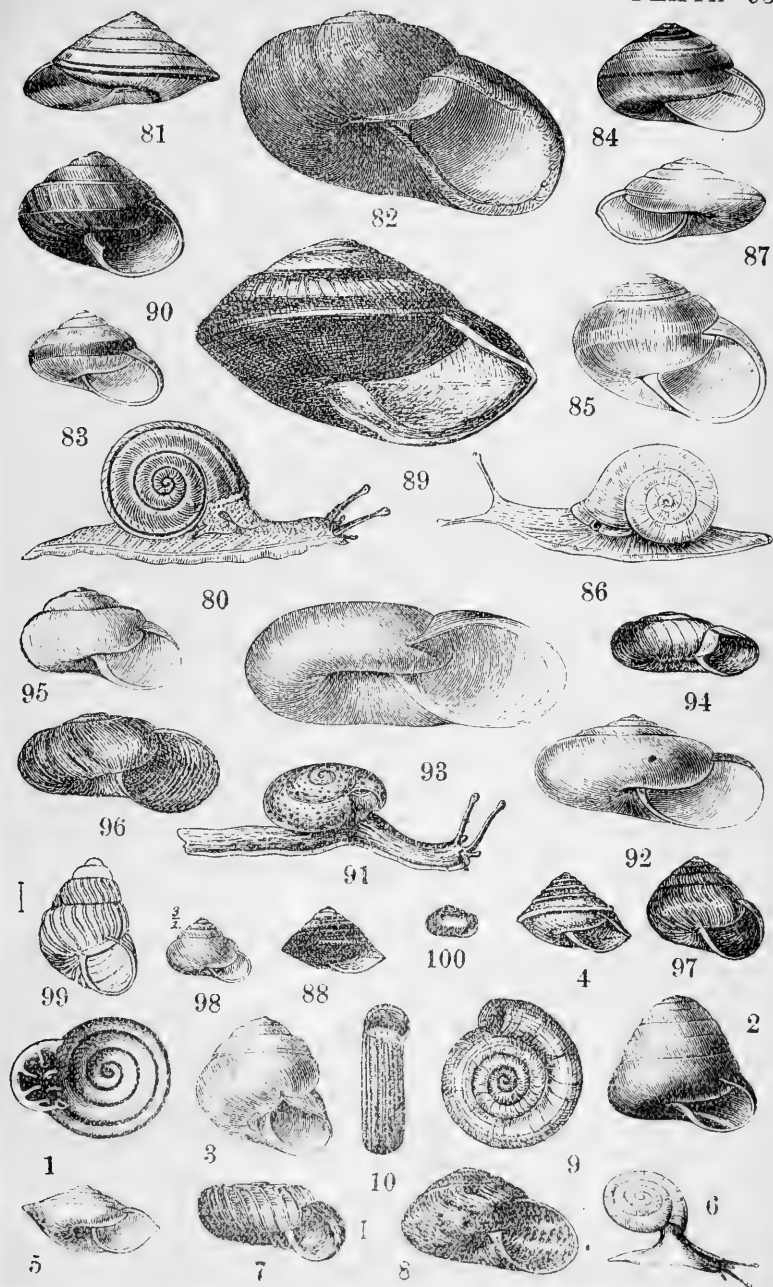
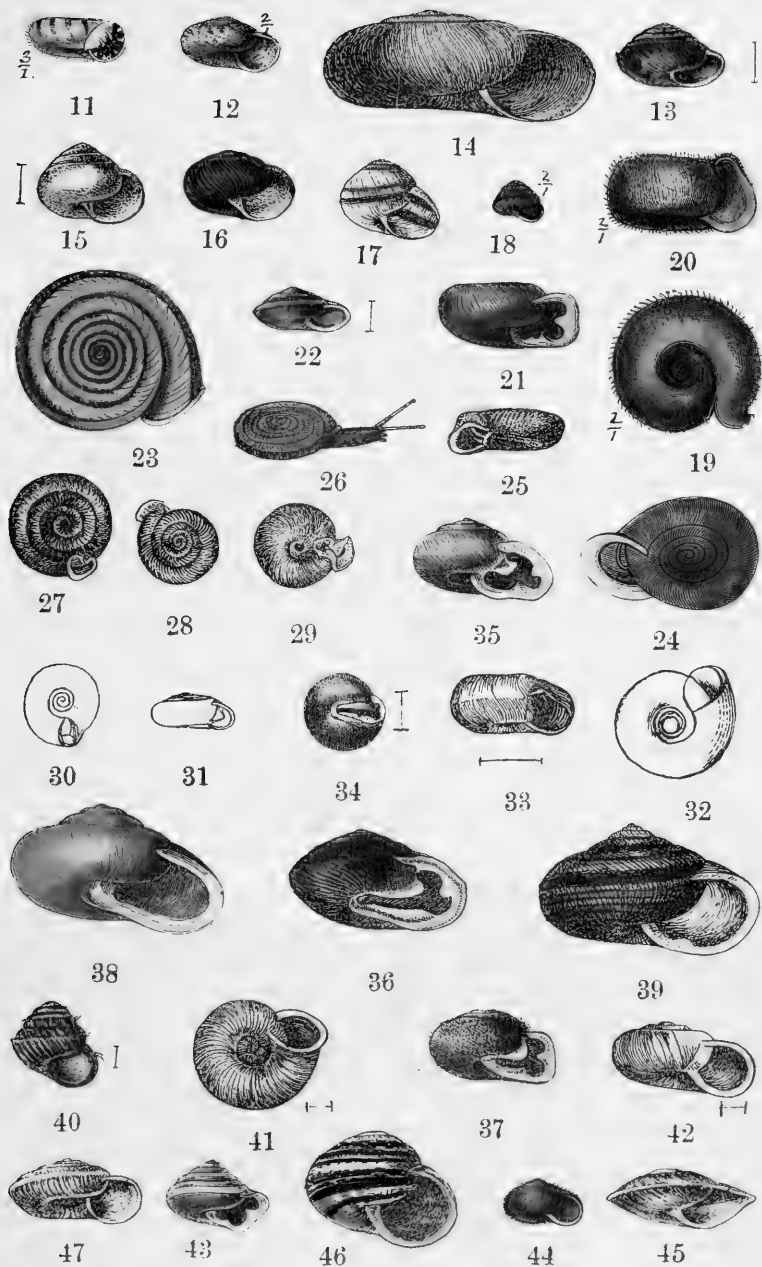


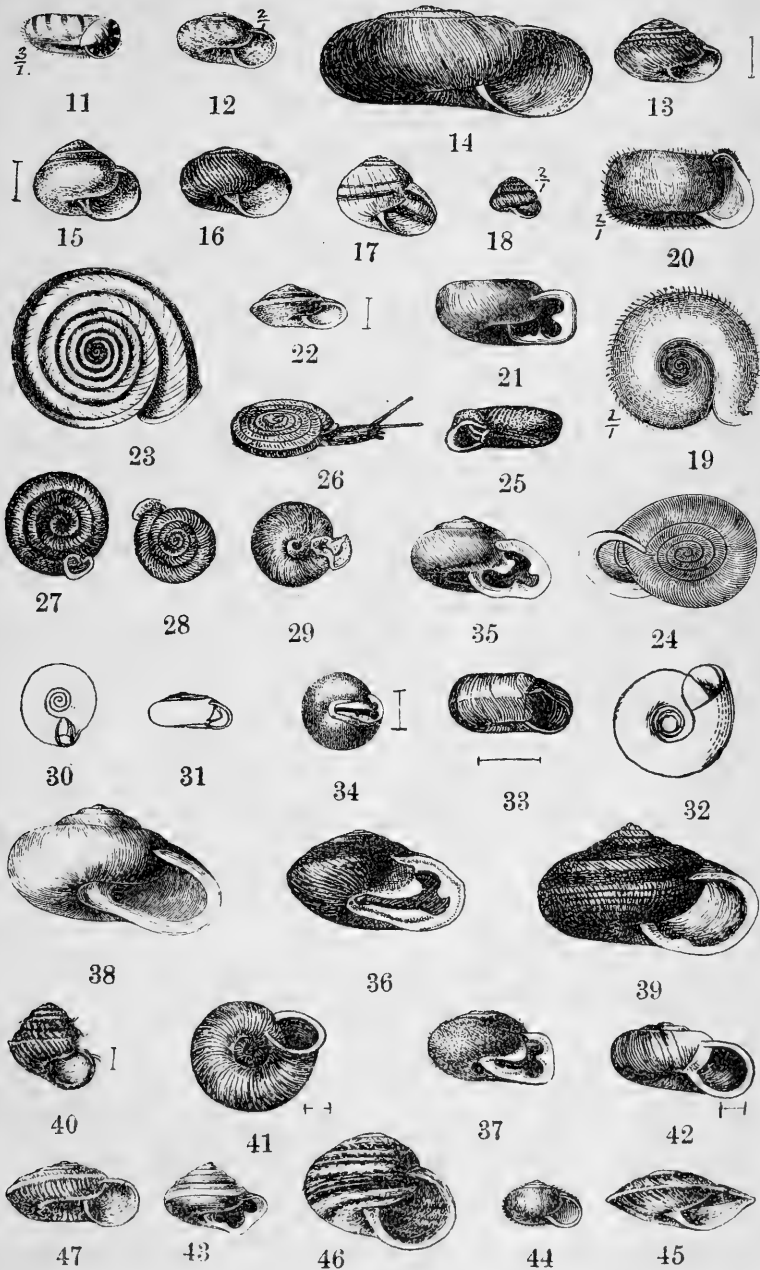
PLATE 93



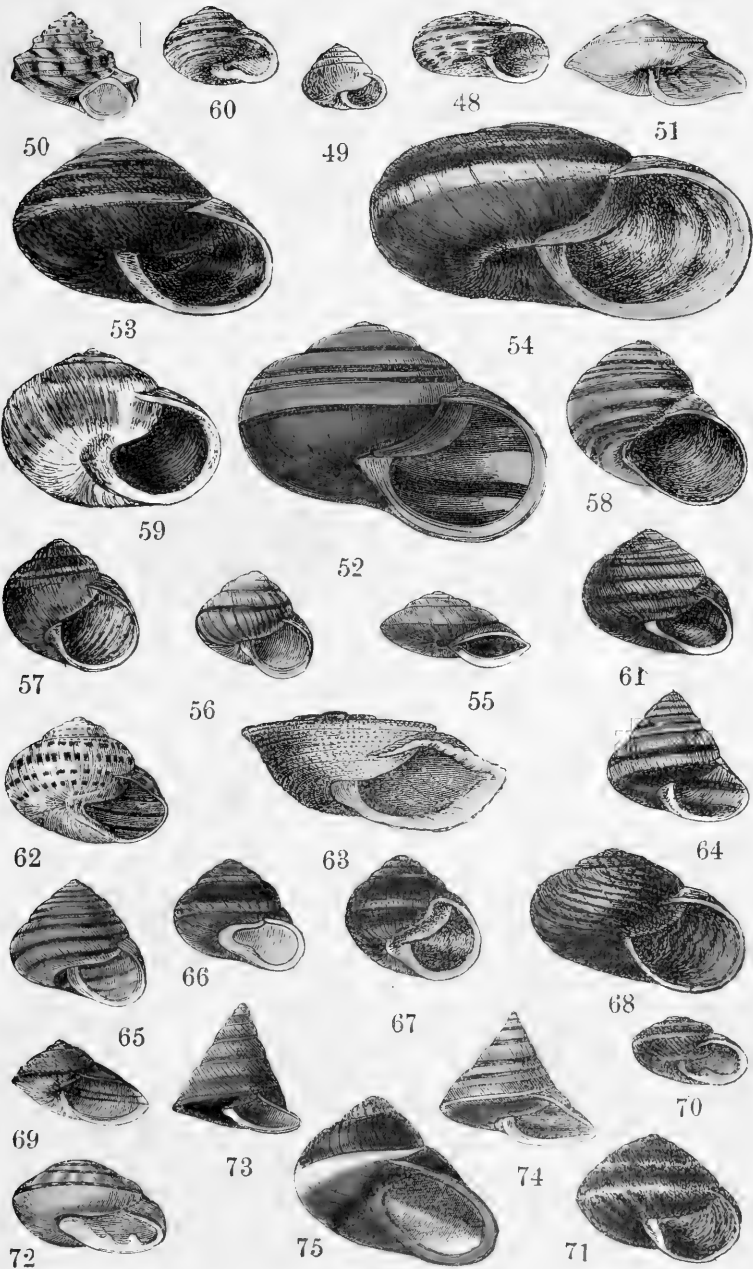


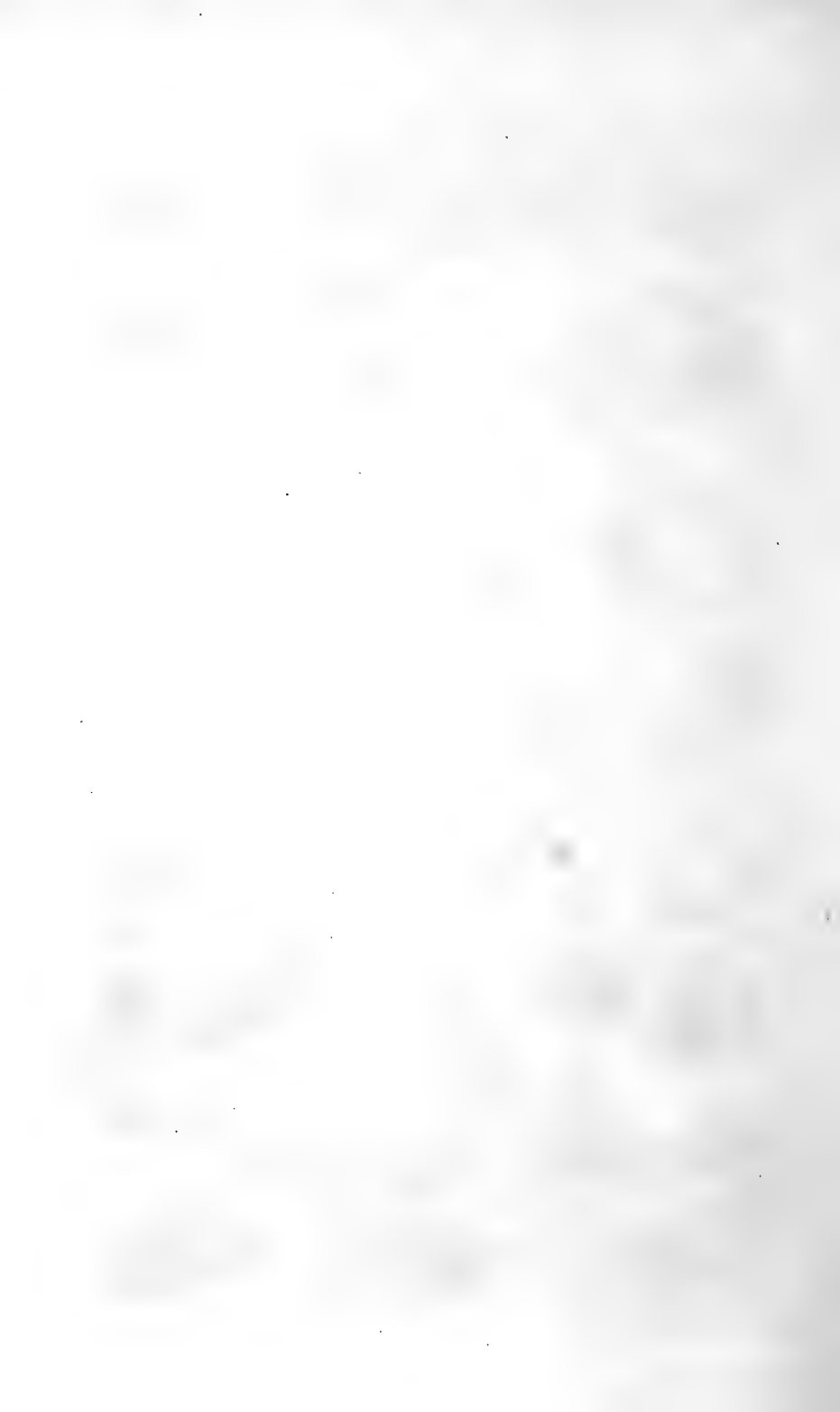


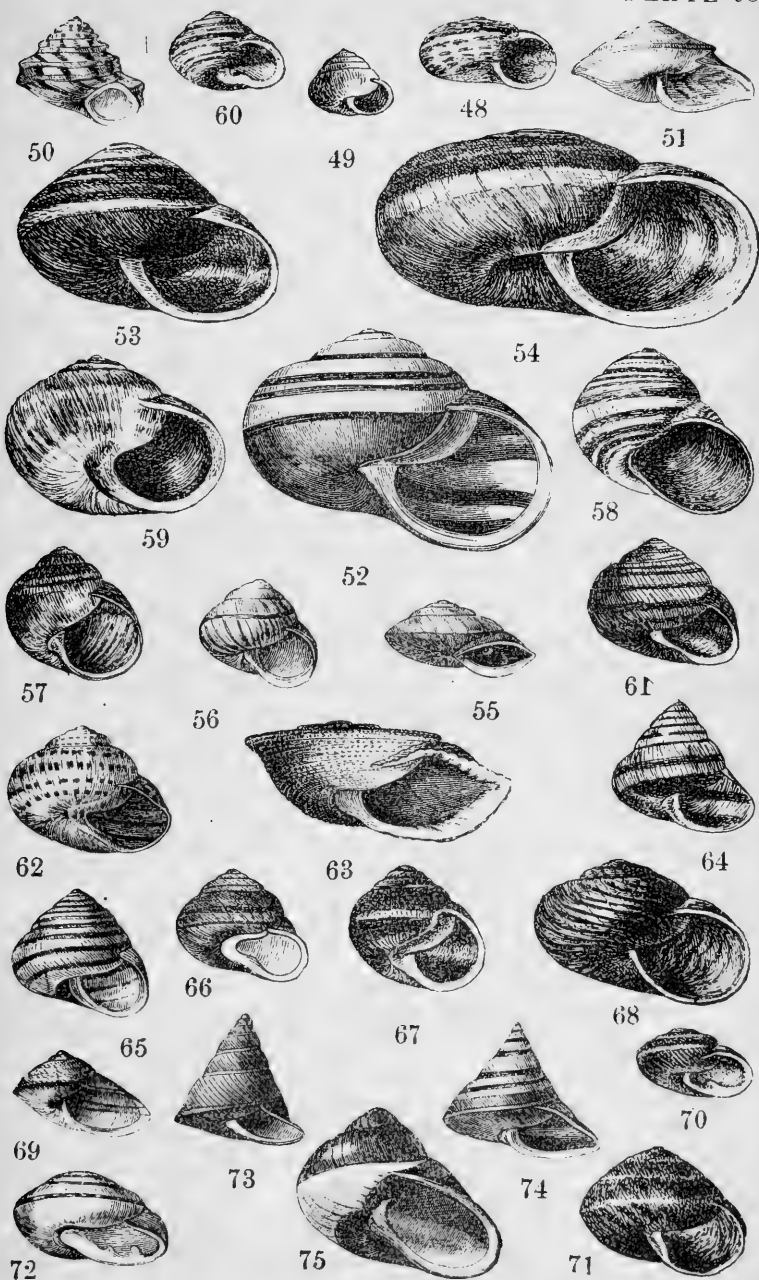


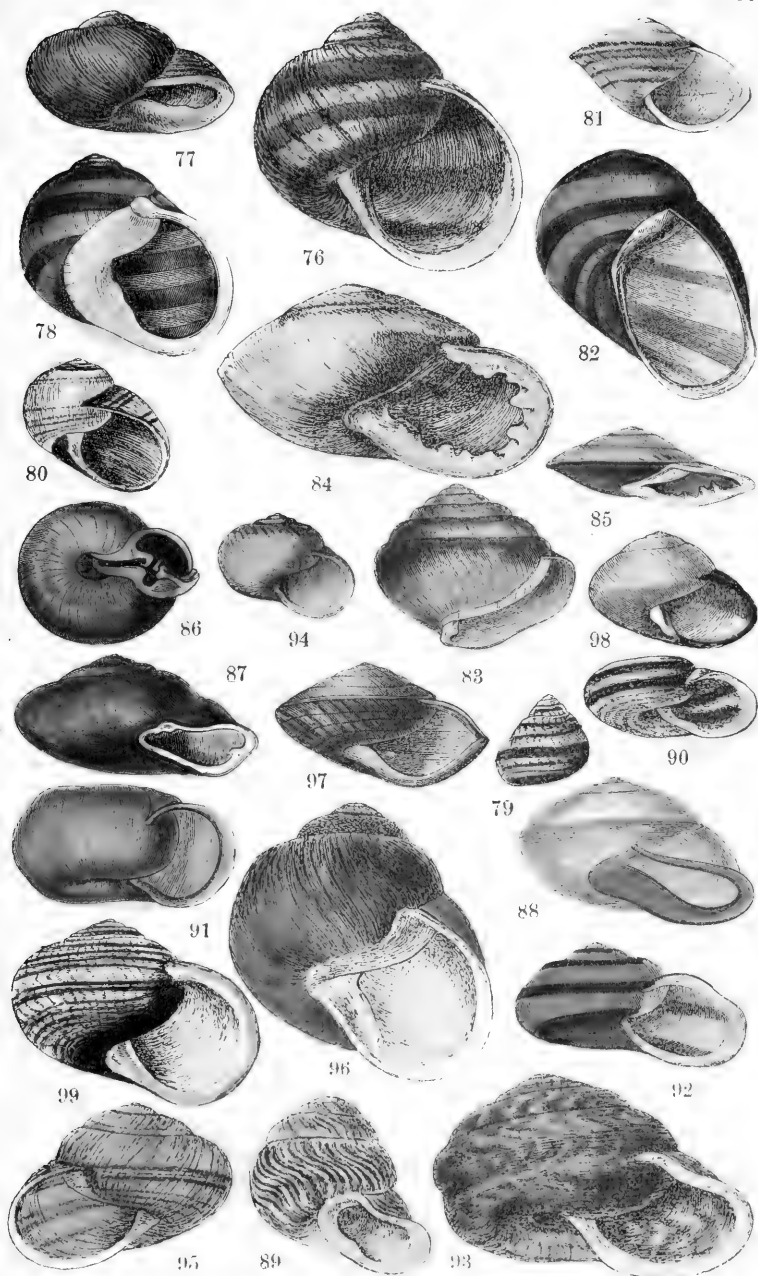




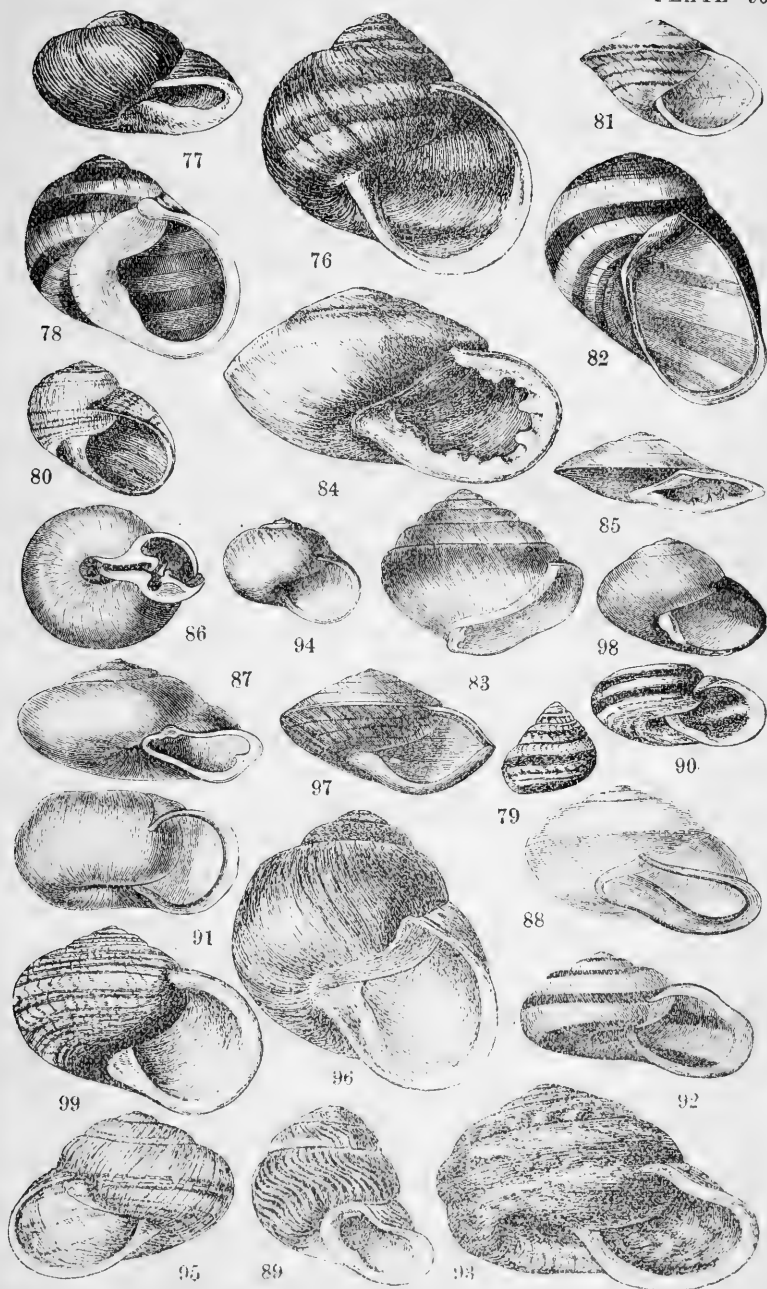


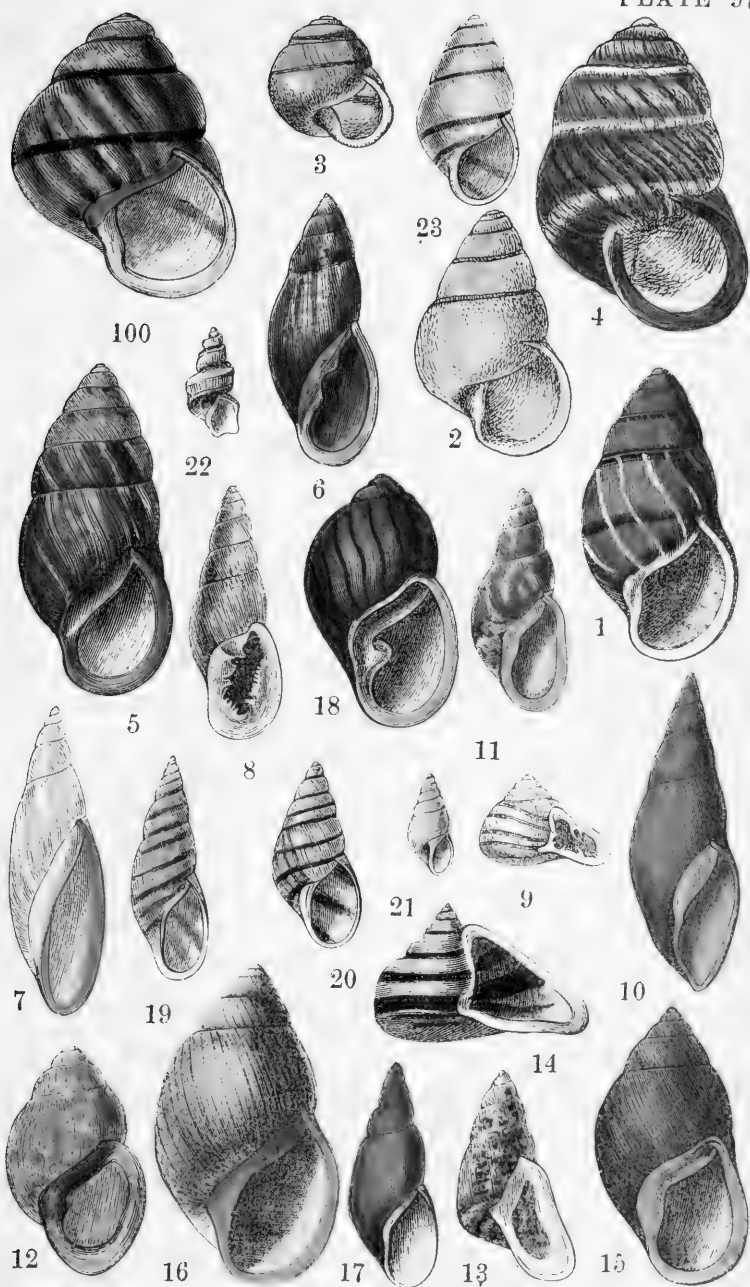




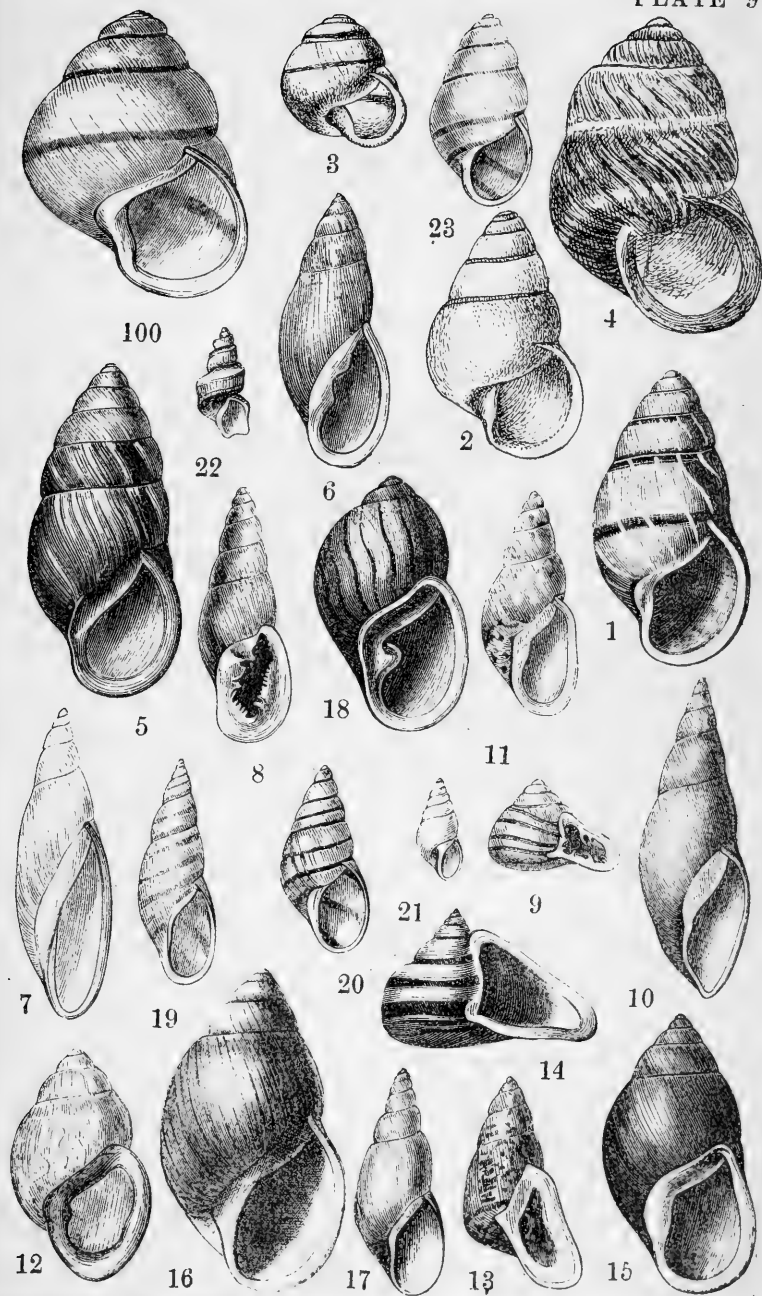


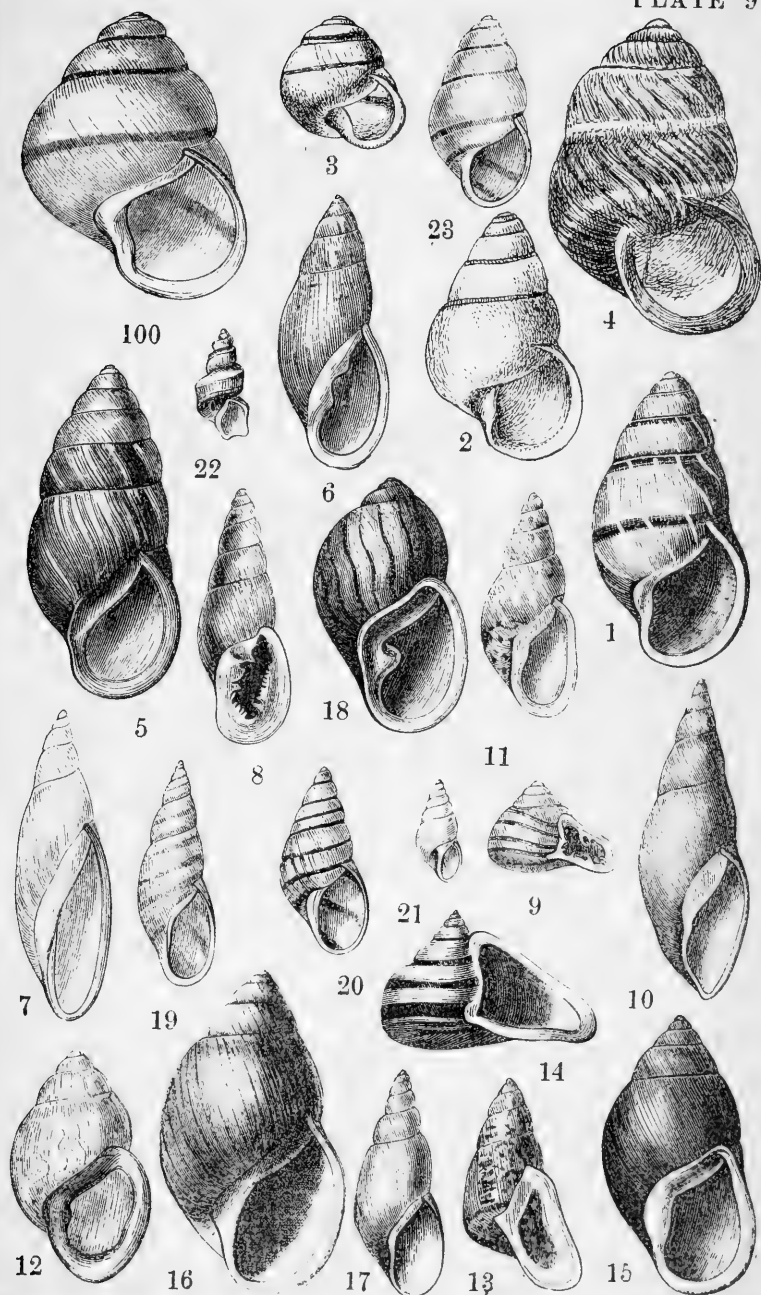


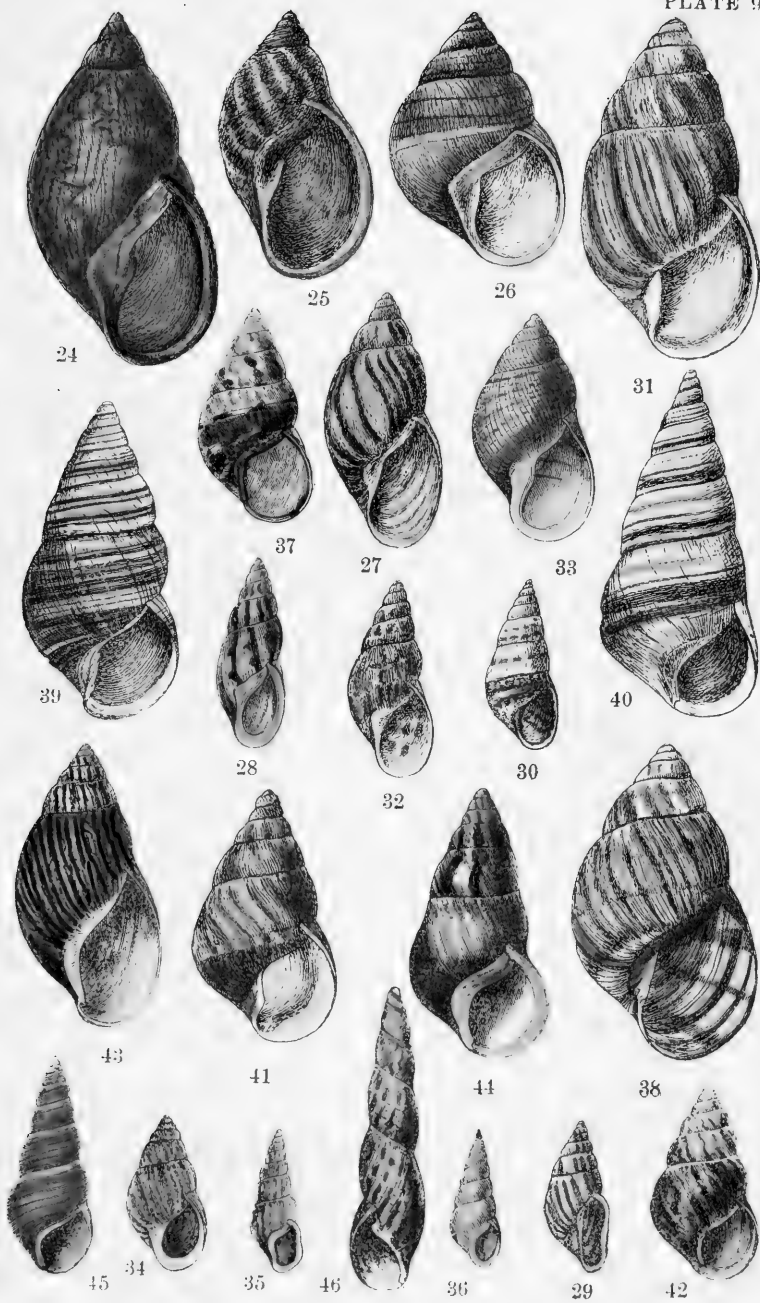




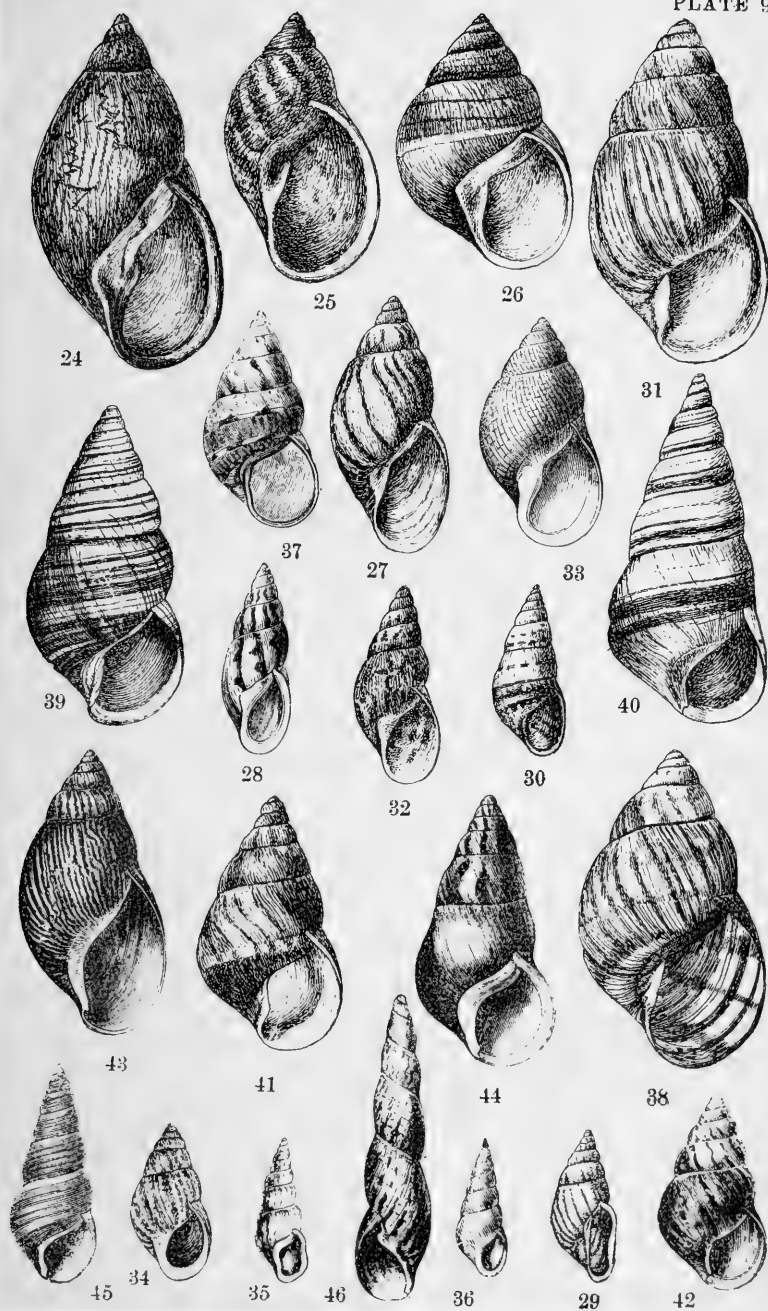




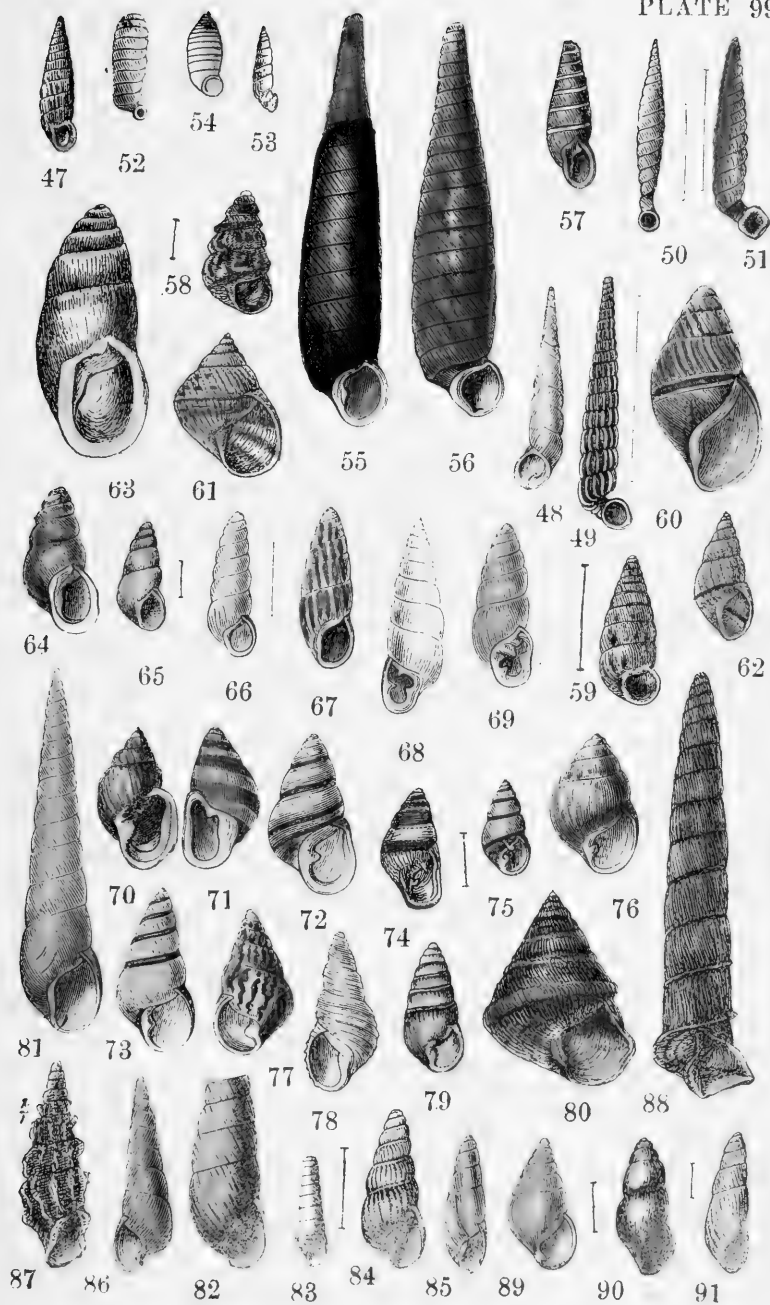


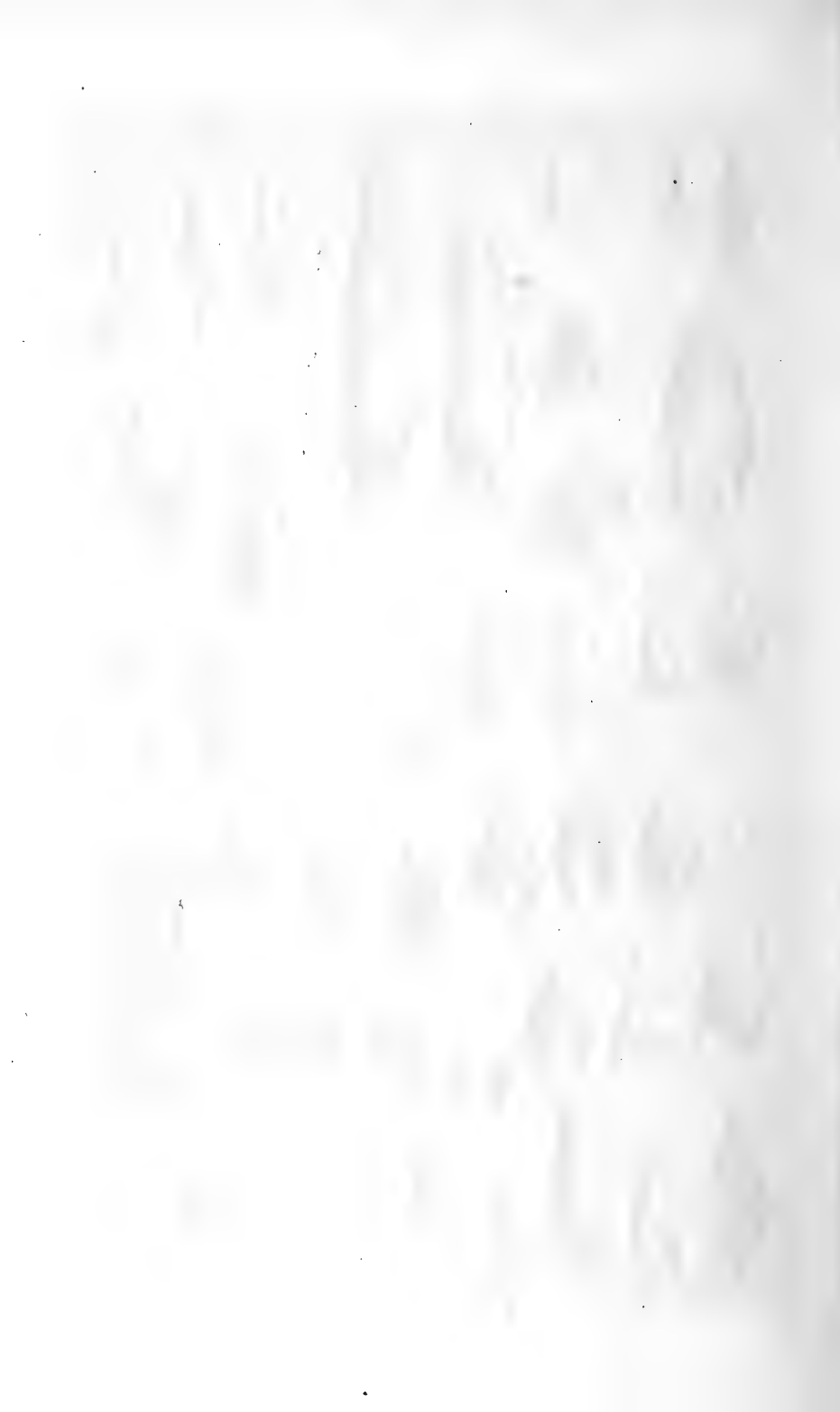


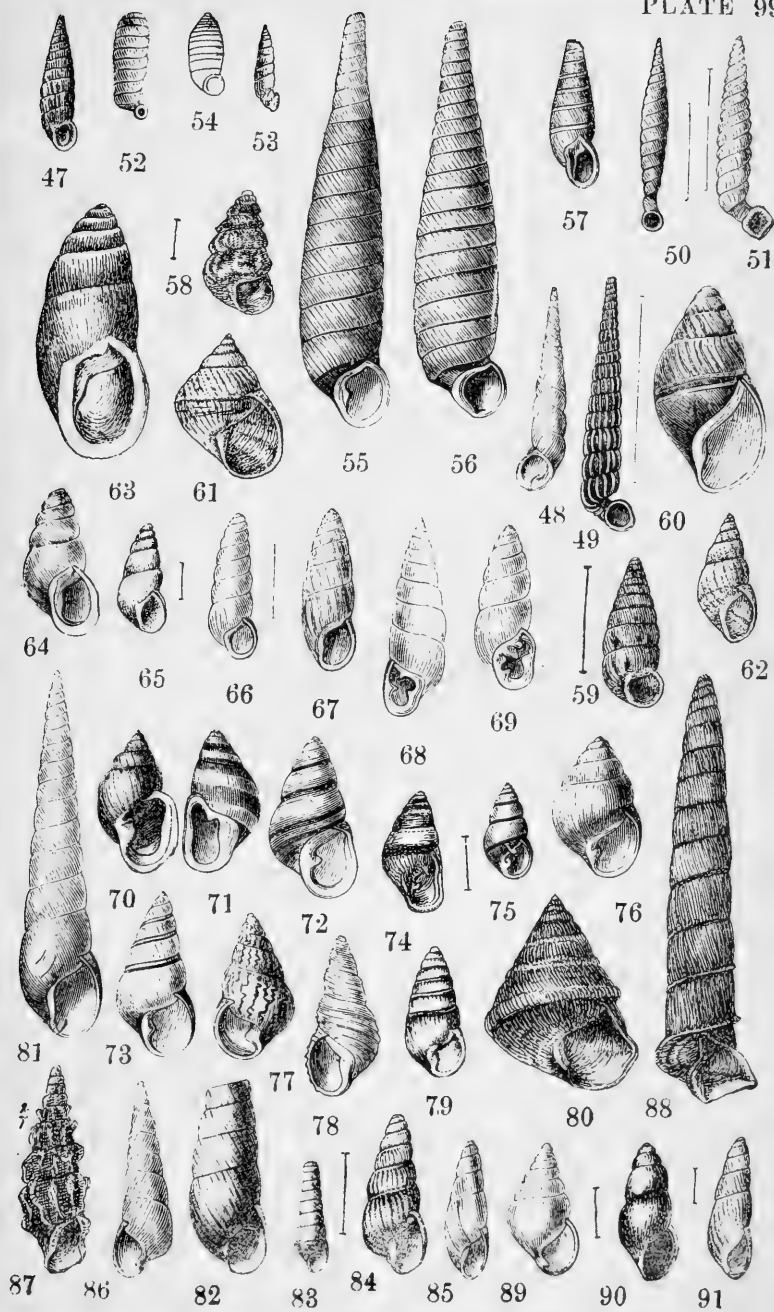


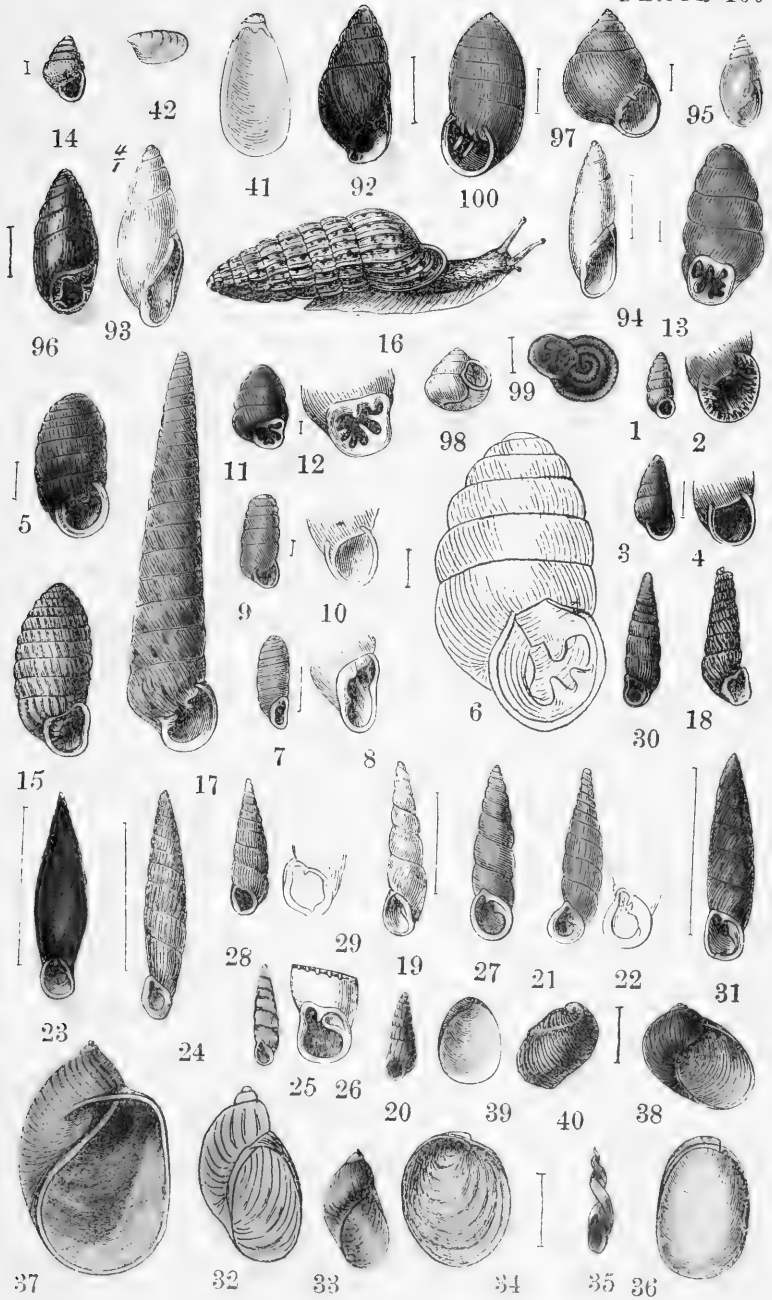


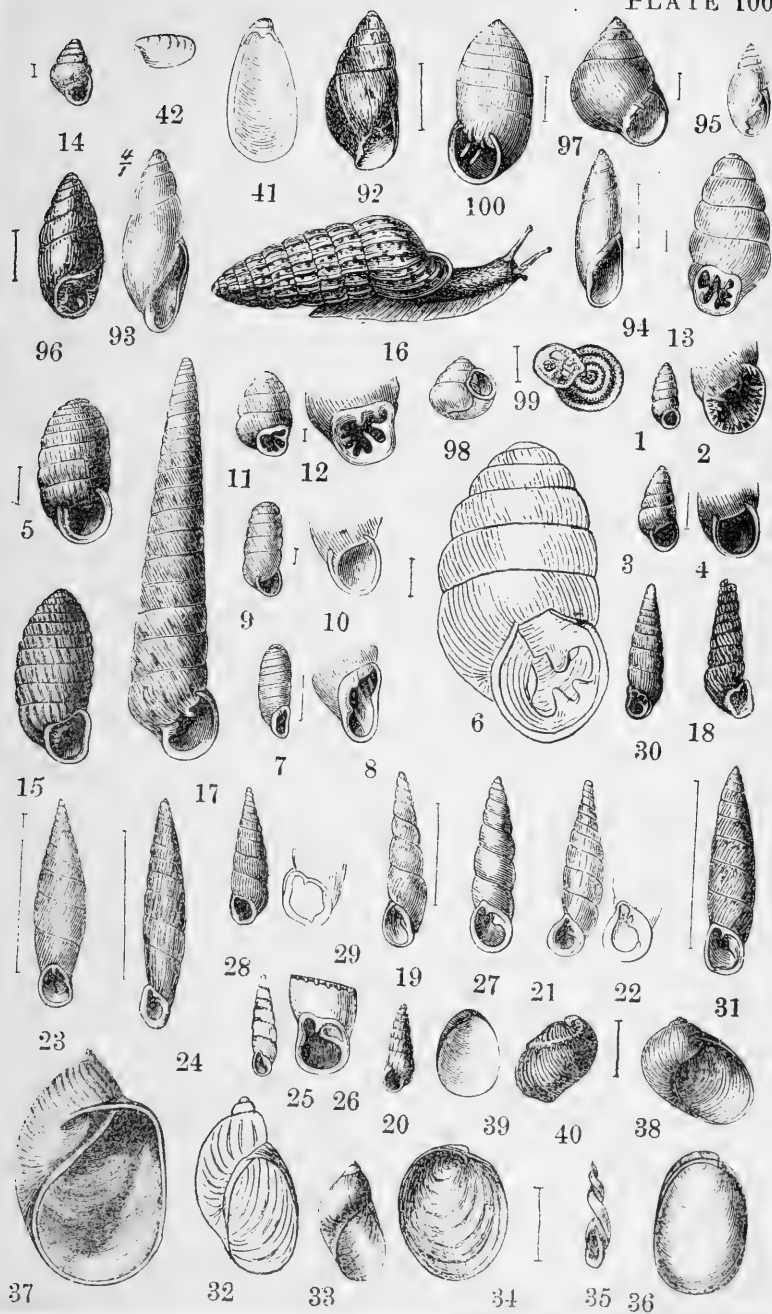


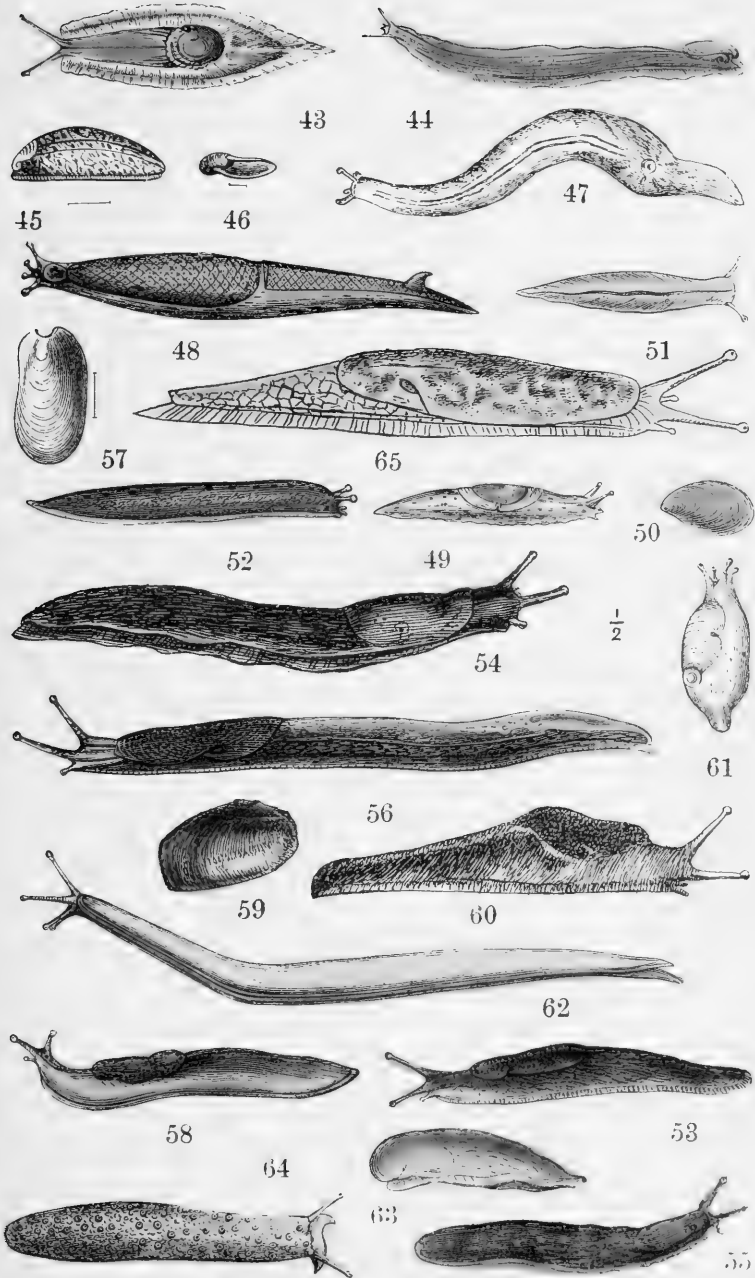


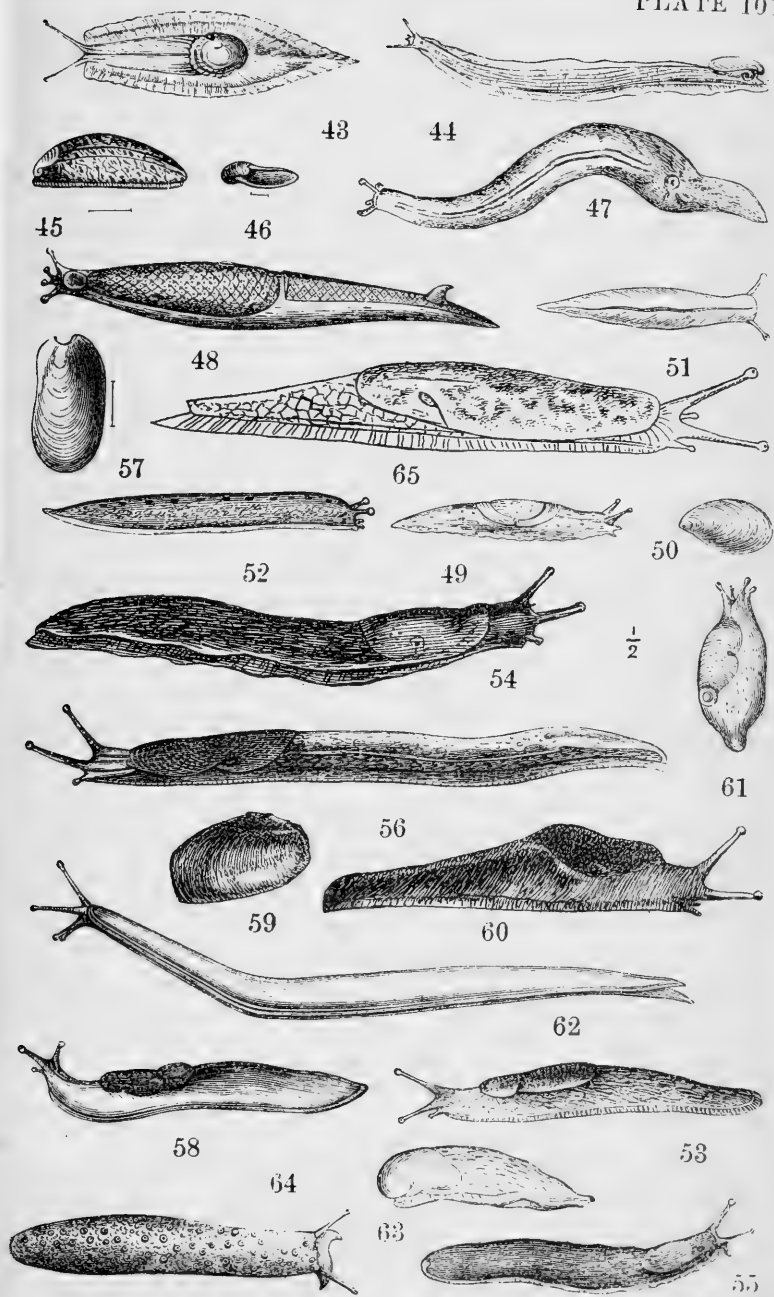


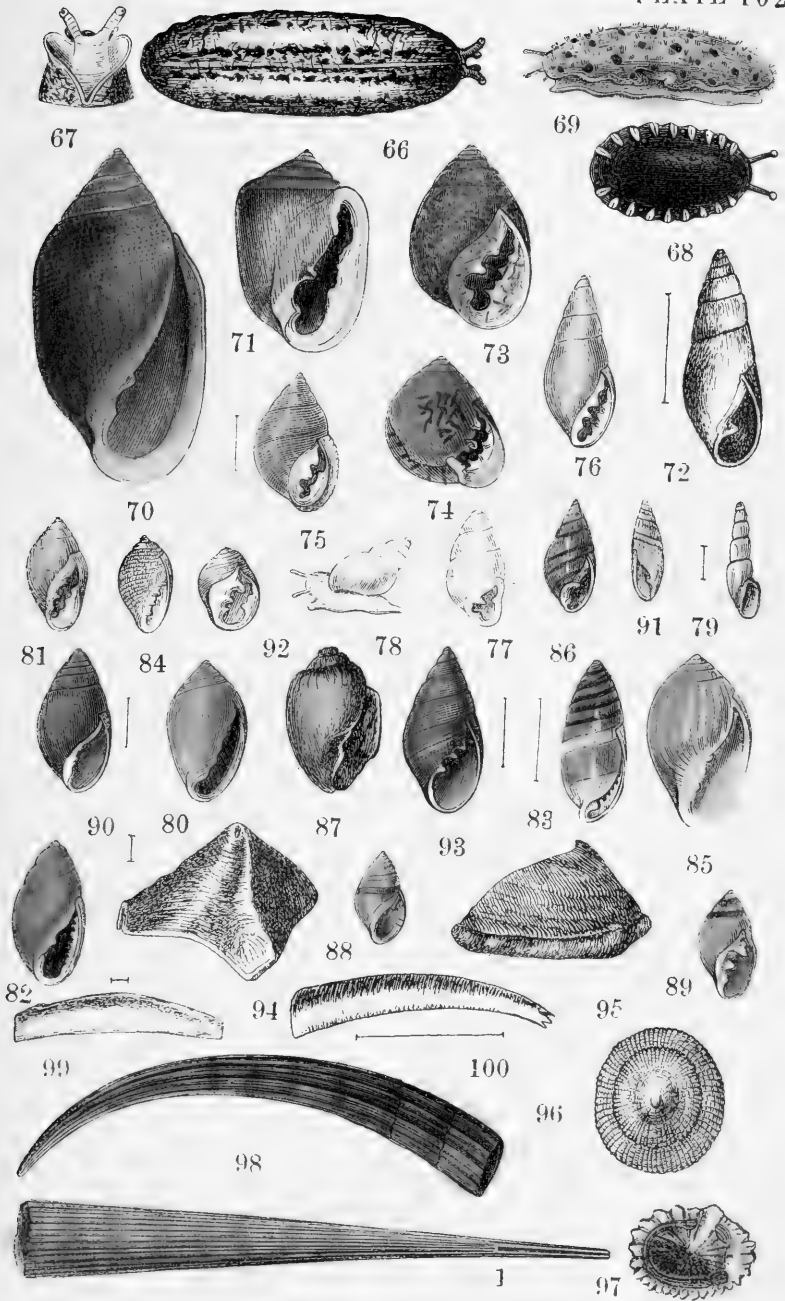




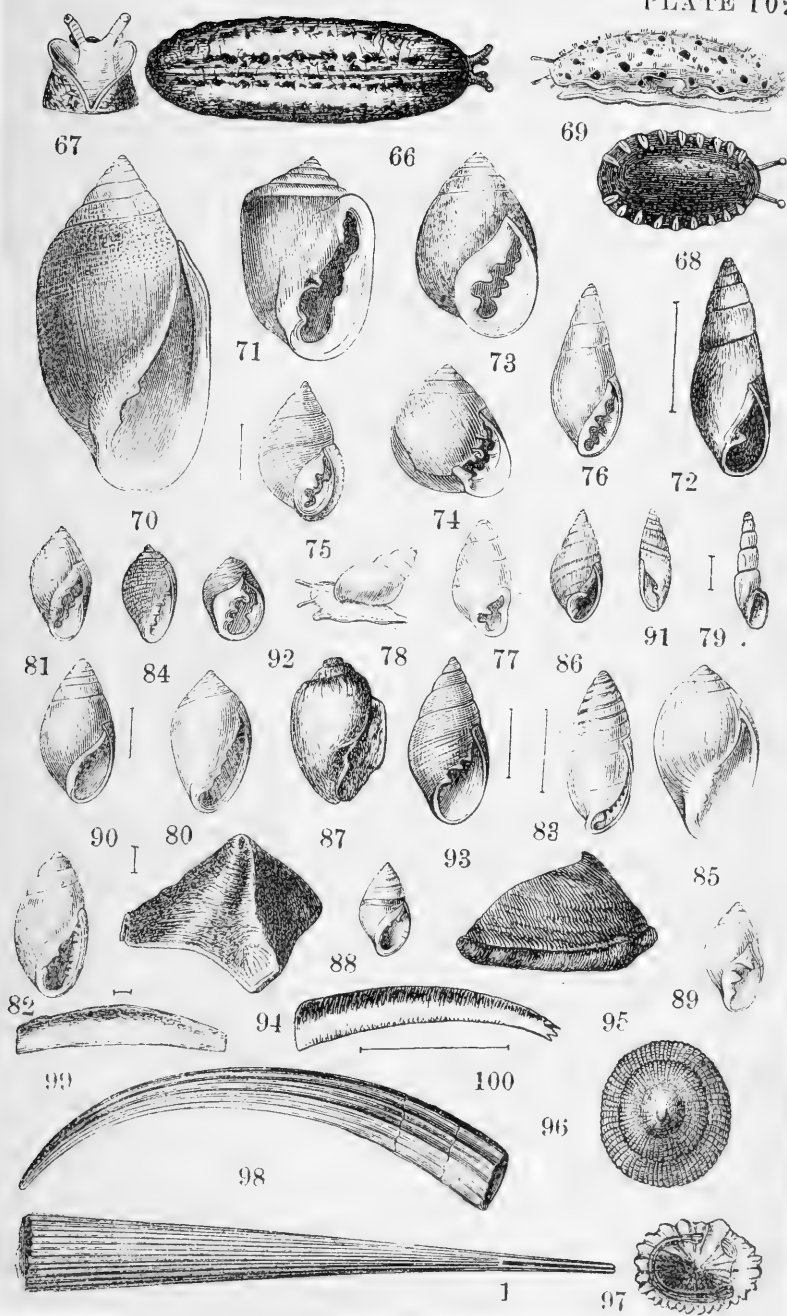


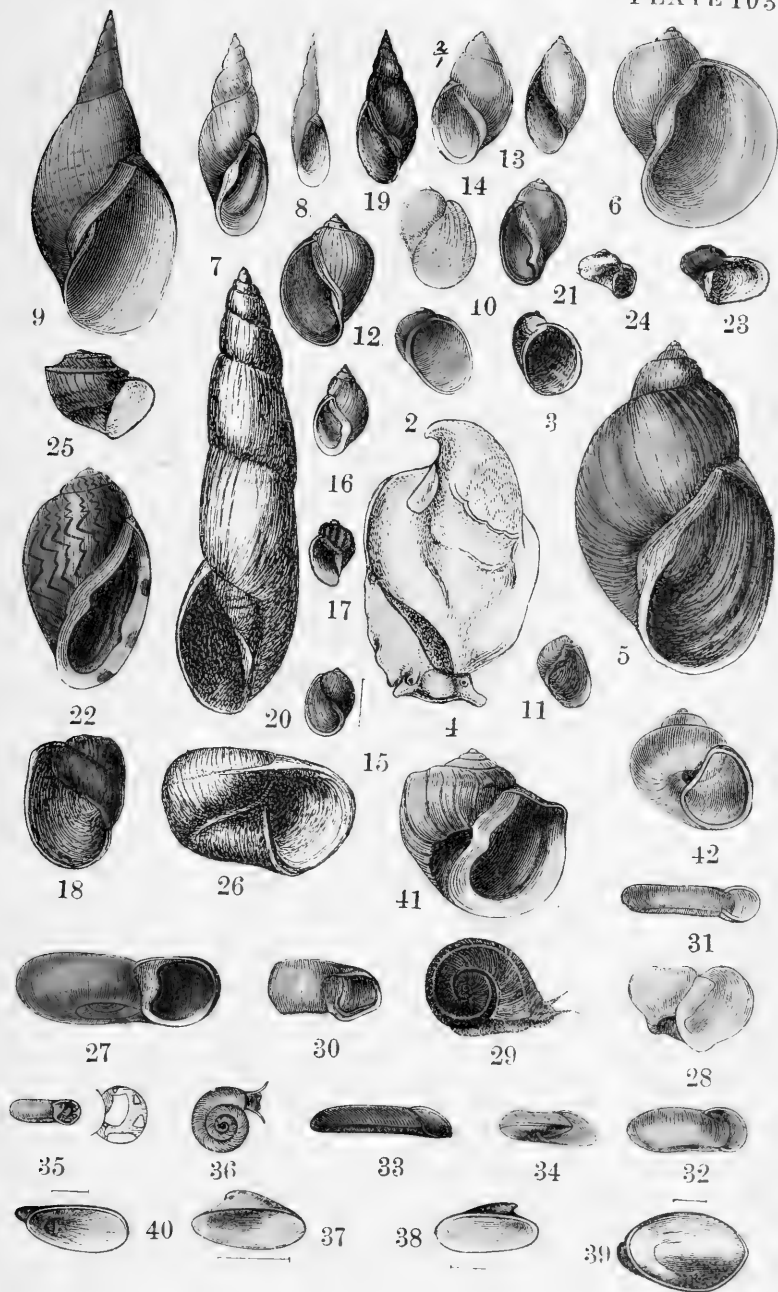


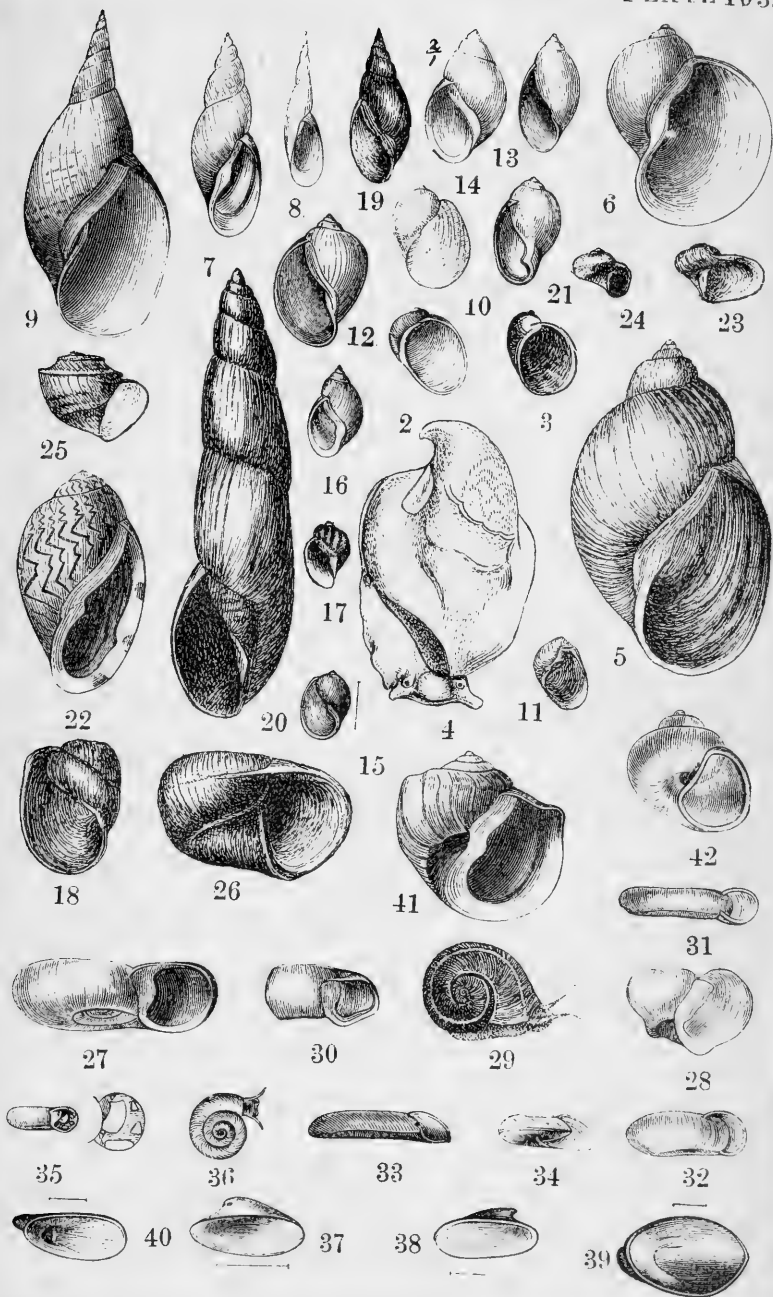


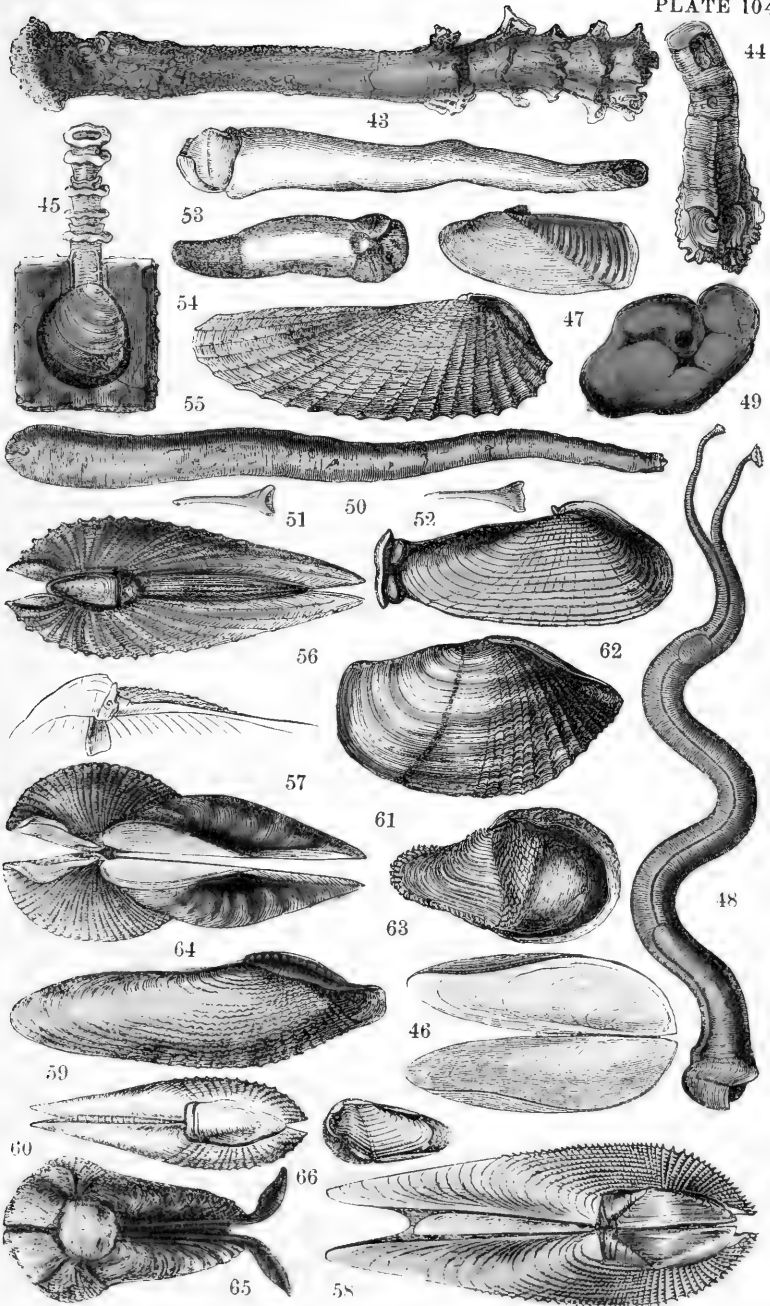


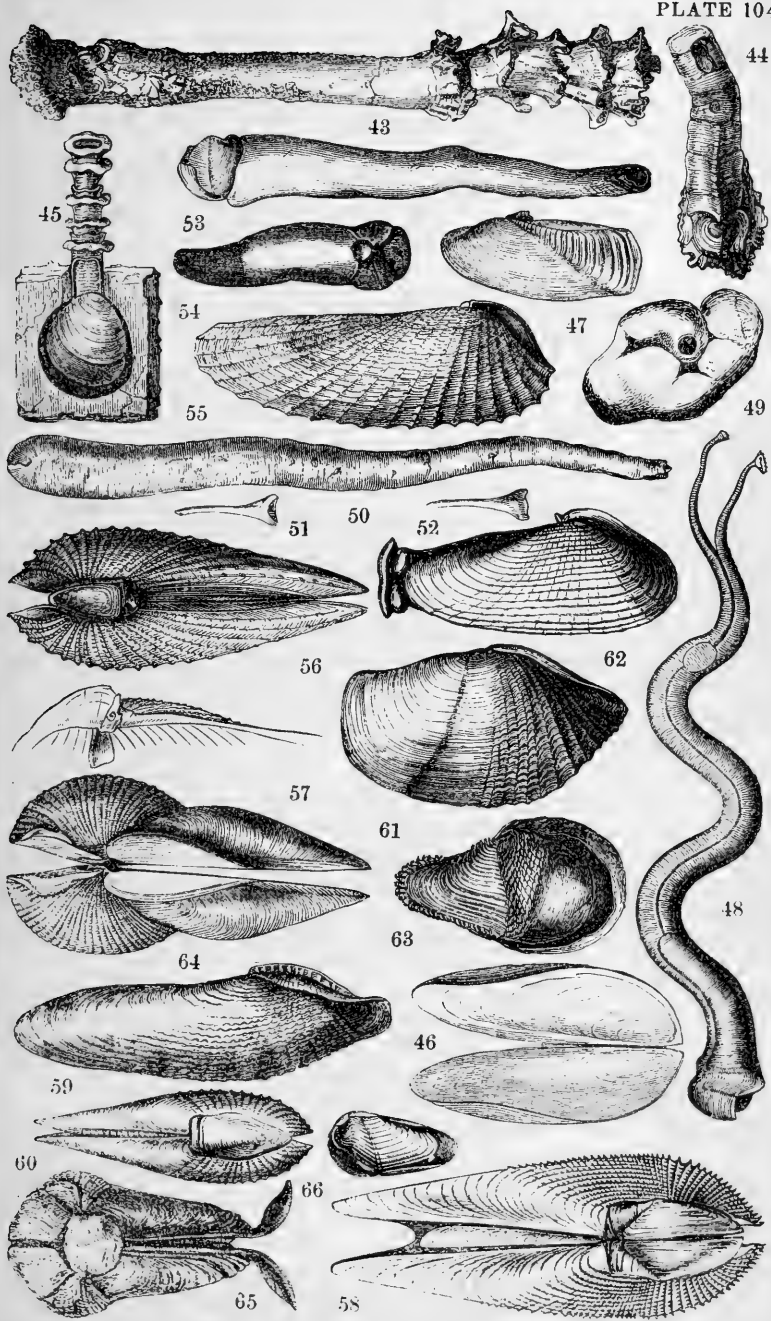


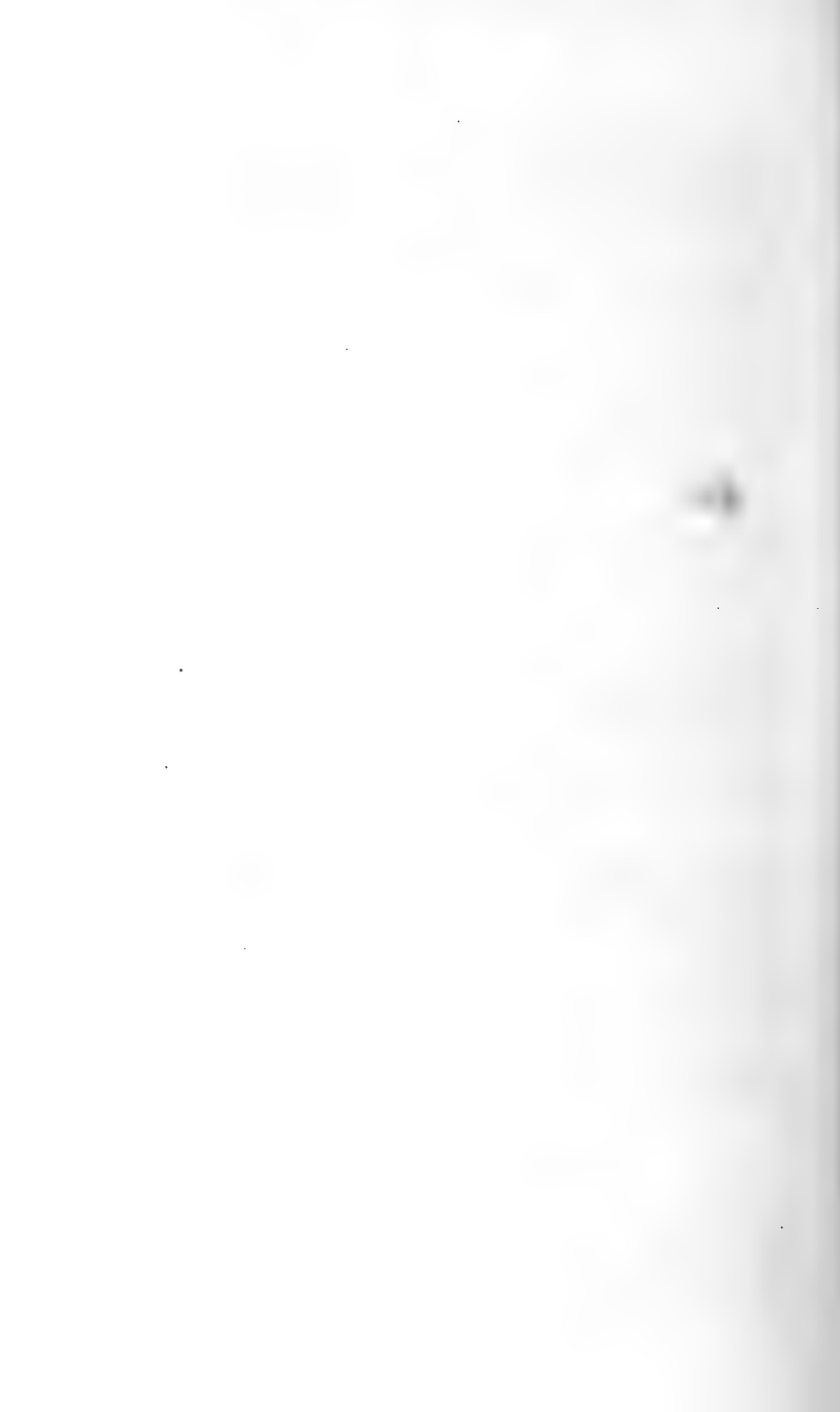


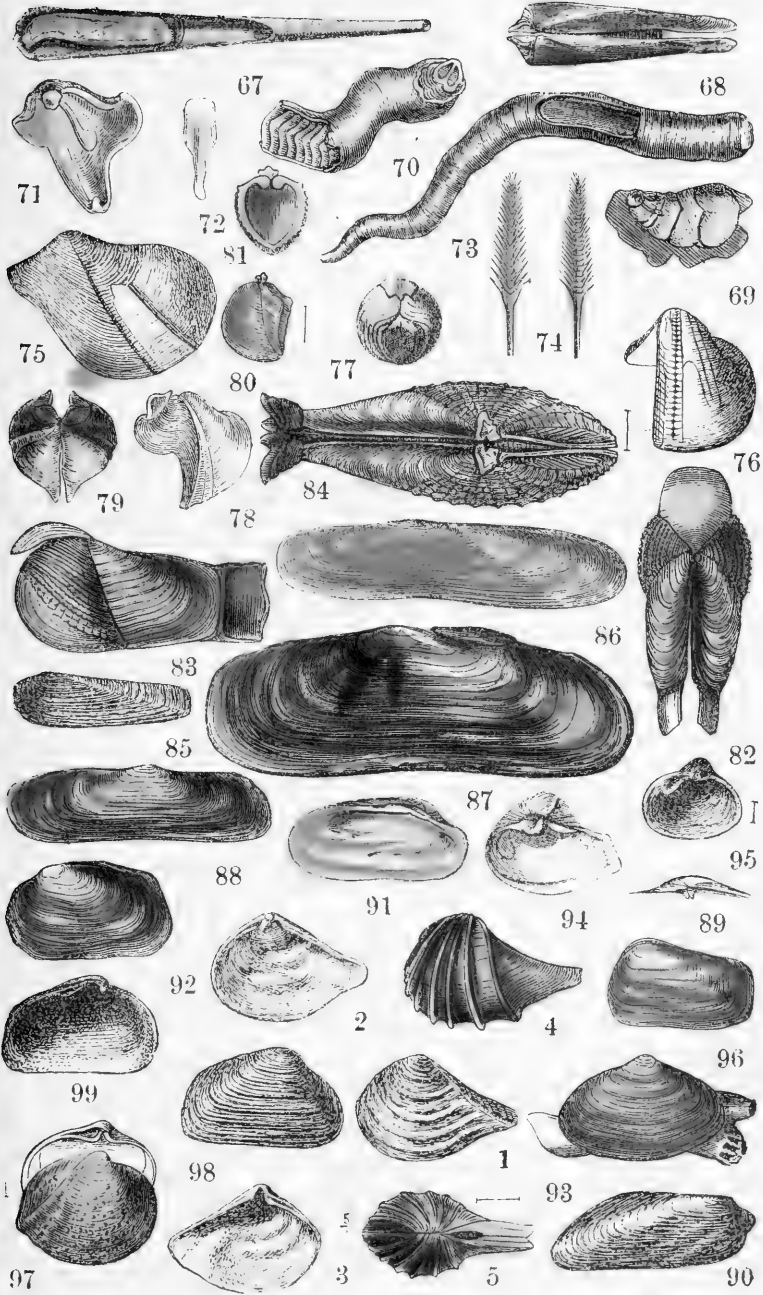


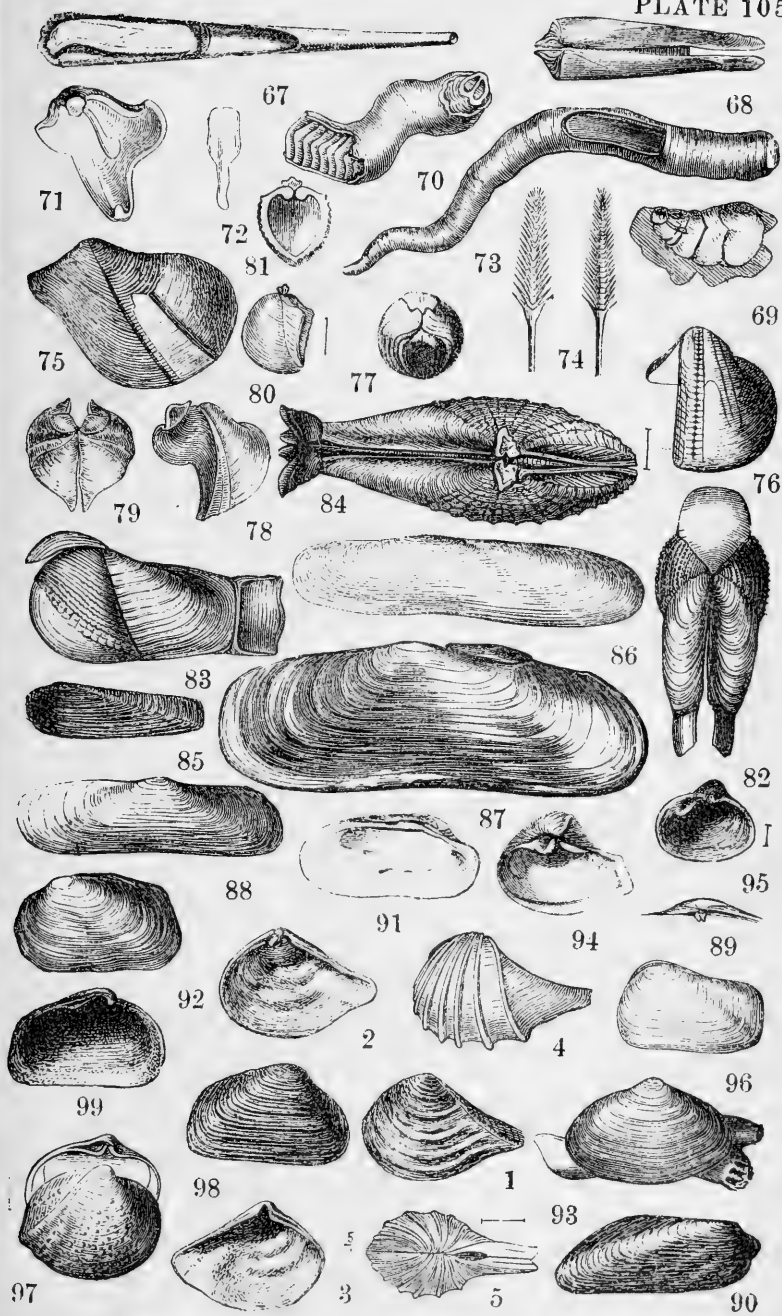




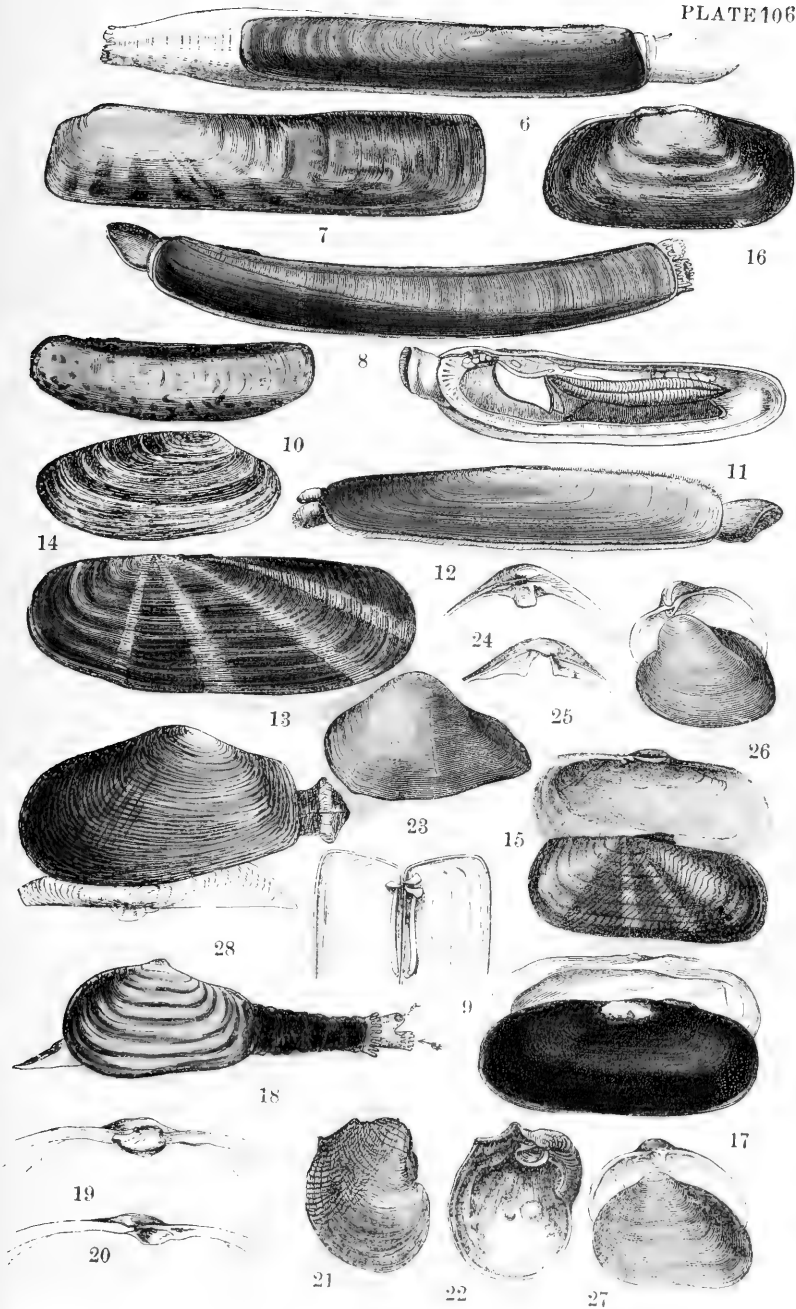




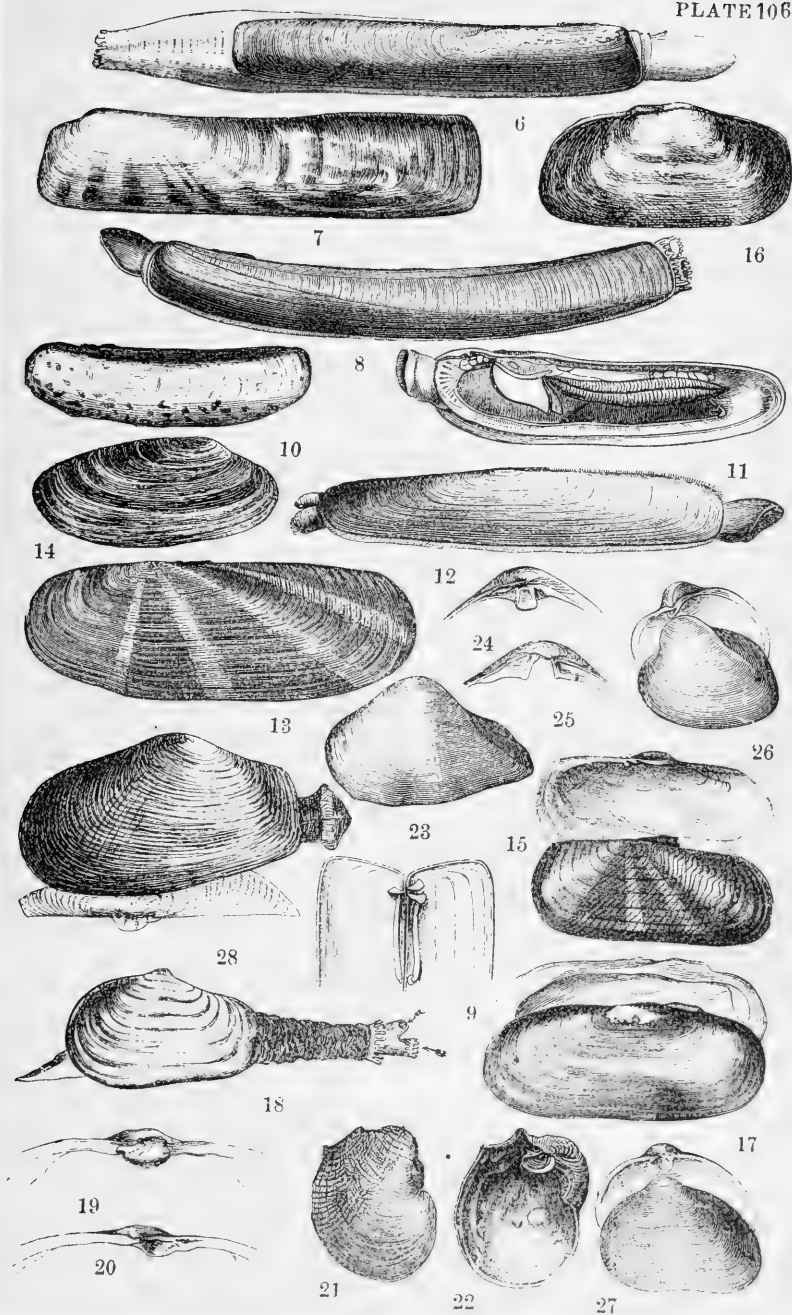


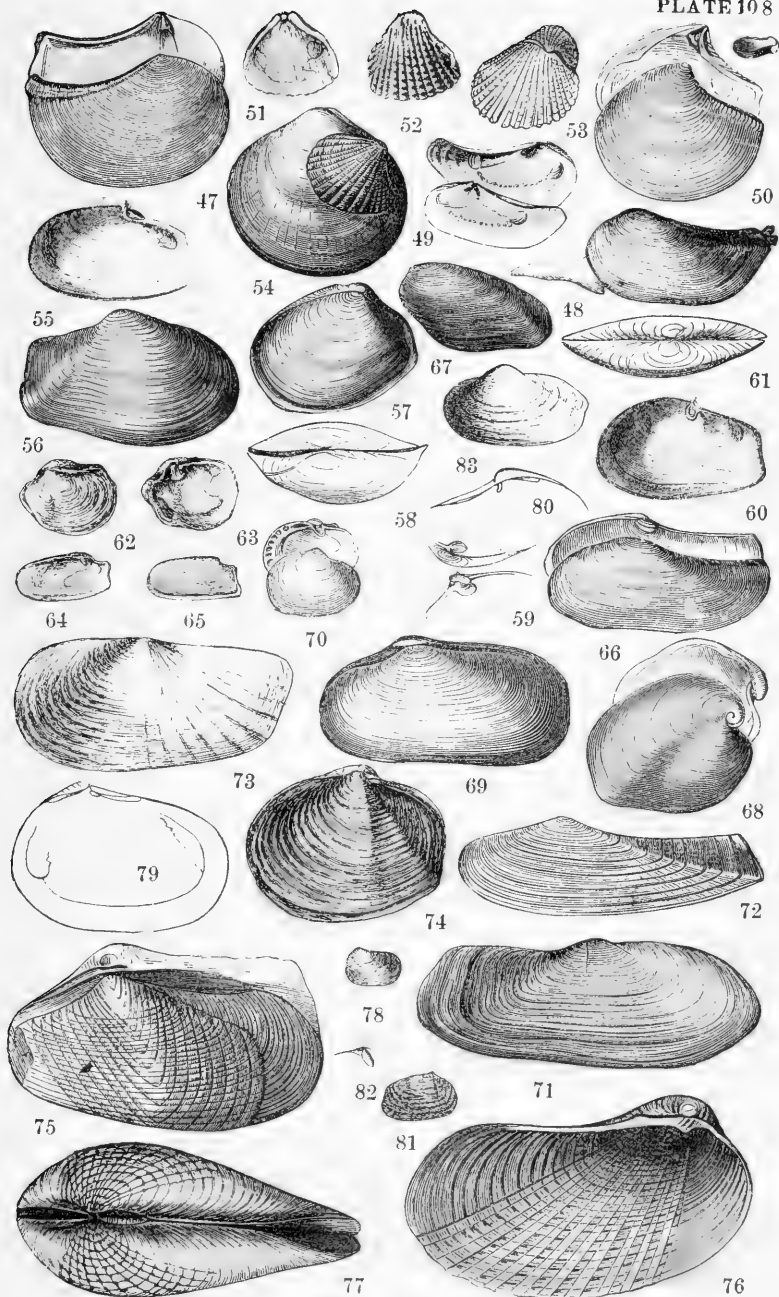


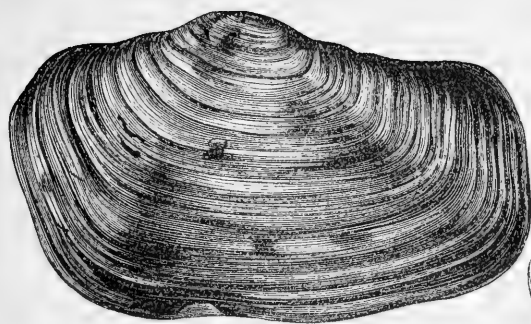




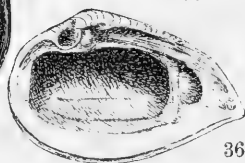








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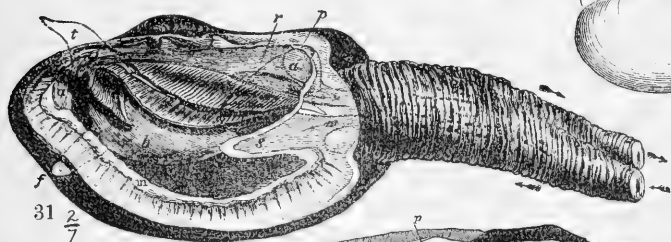
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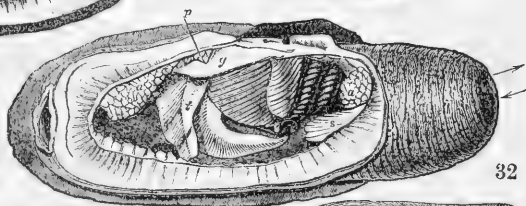
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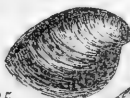
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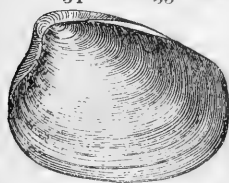
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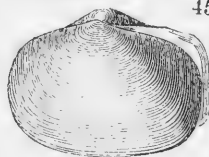
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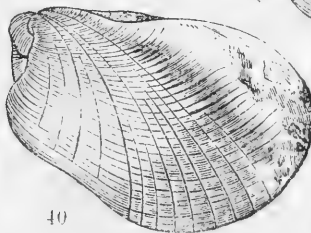
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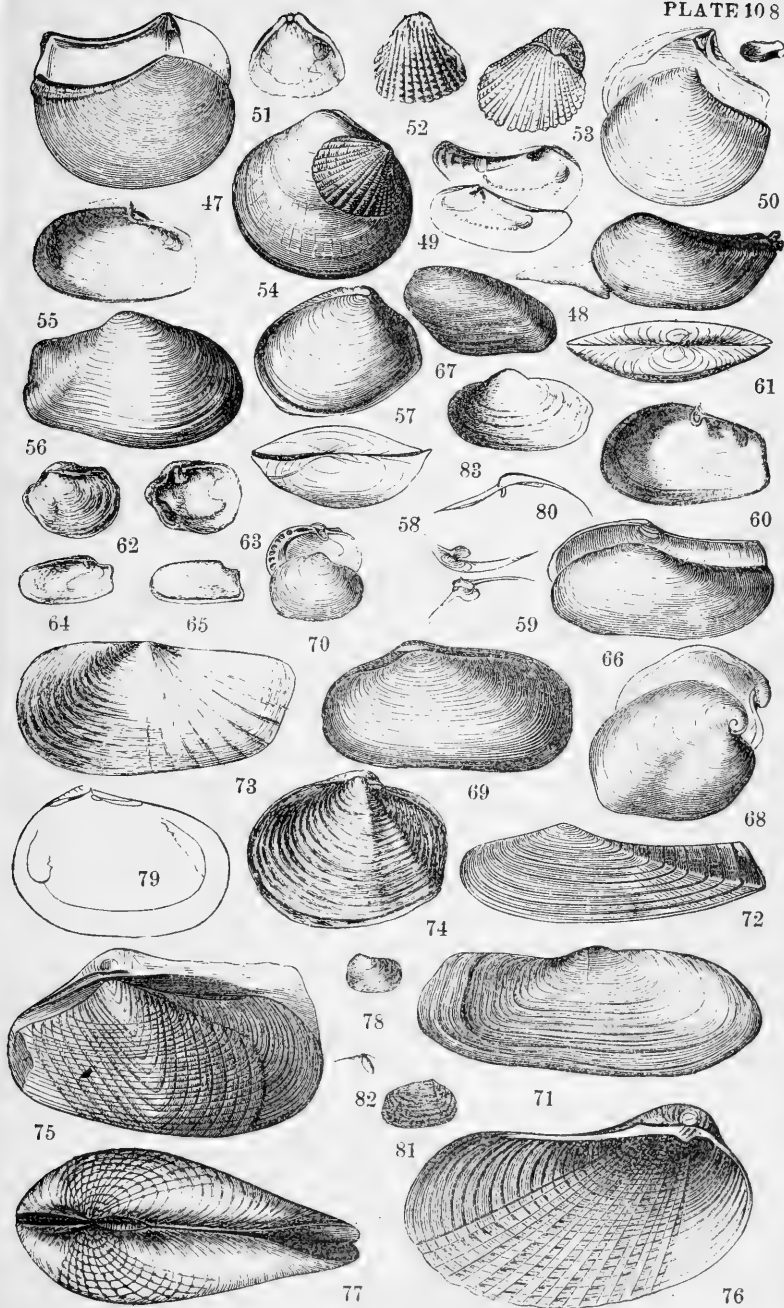
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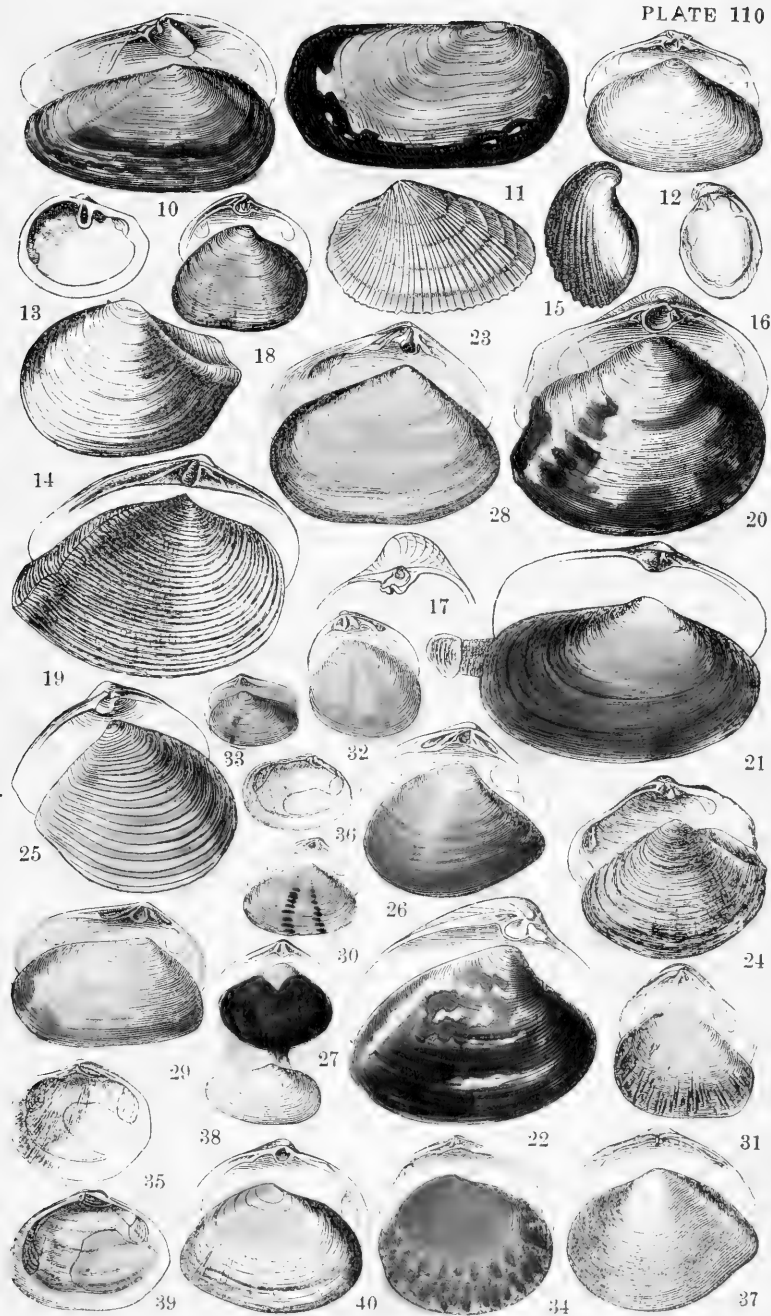


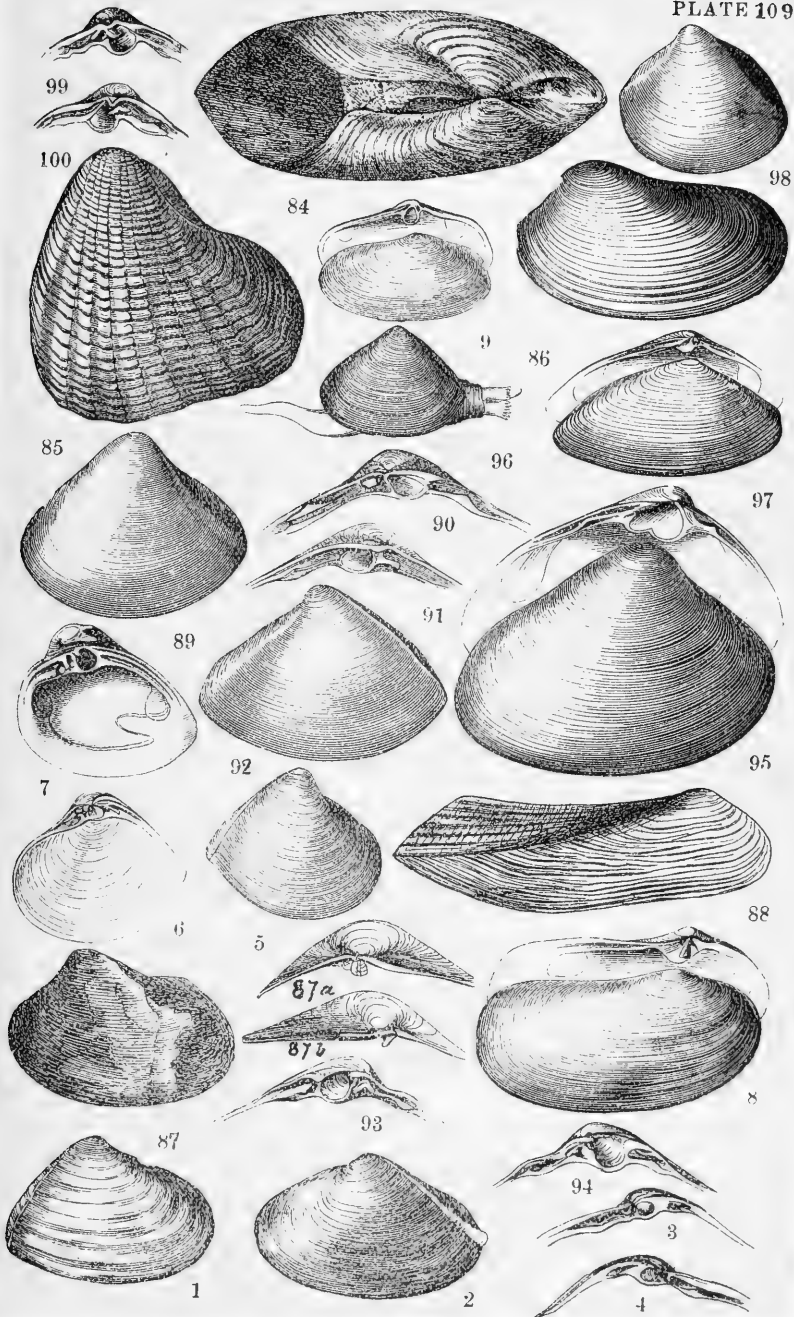
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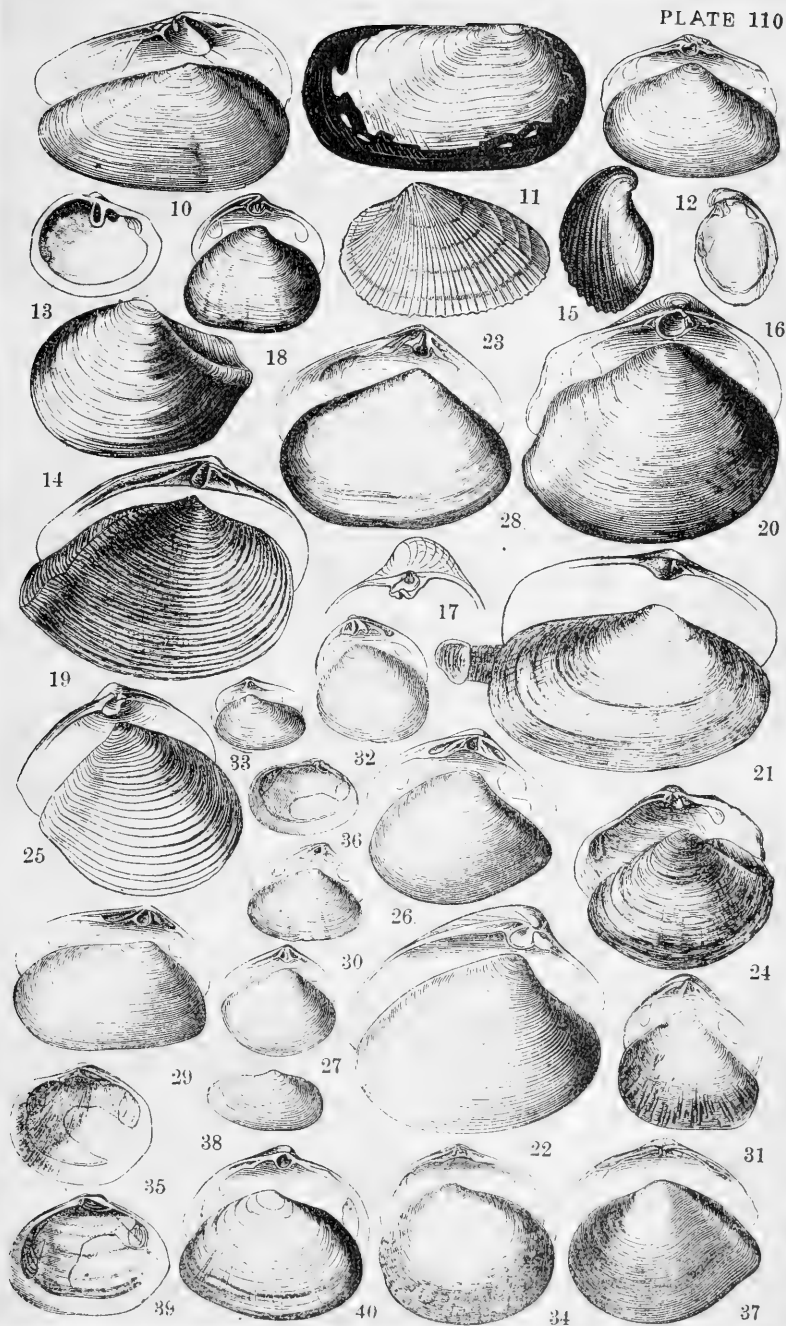


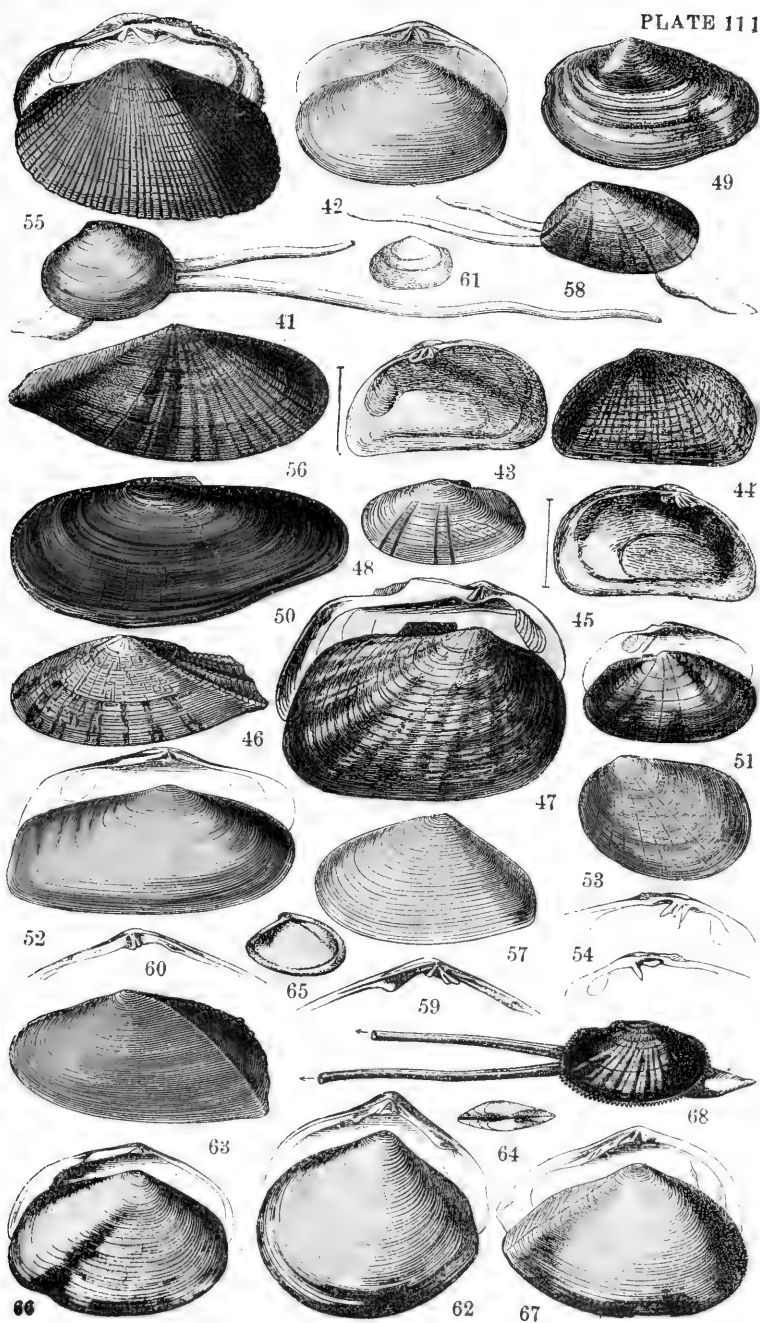
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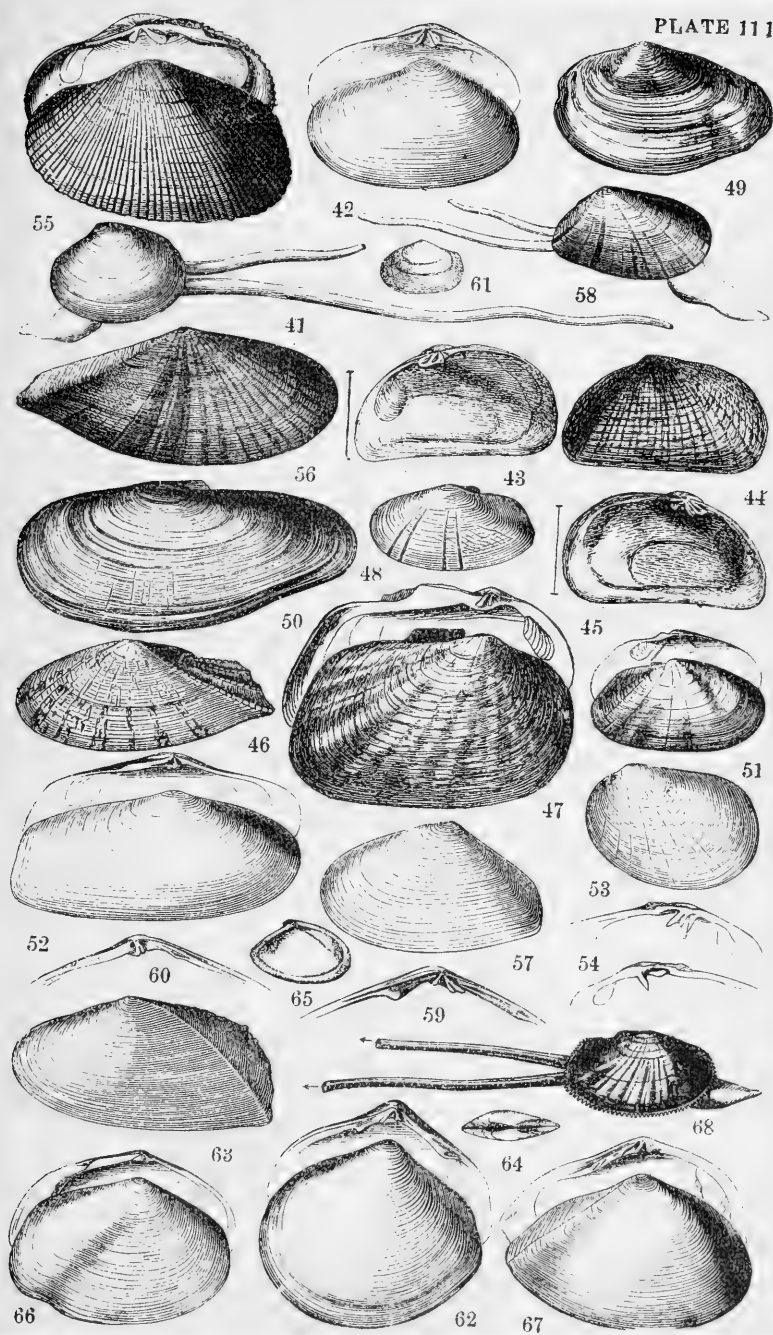


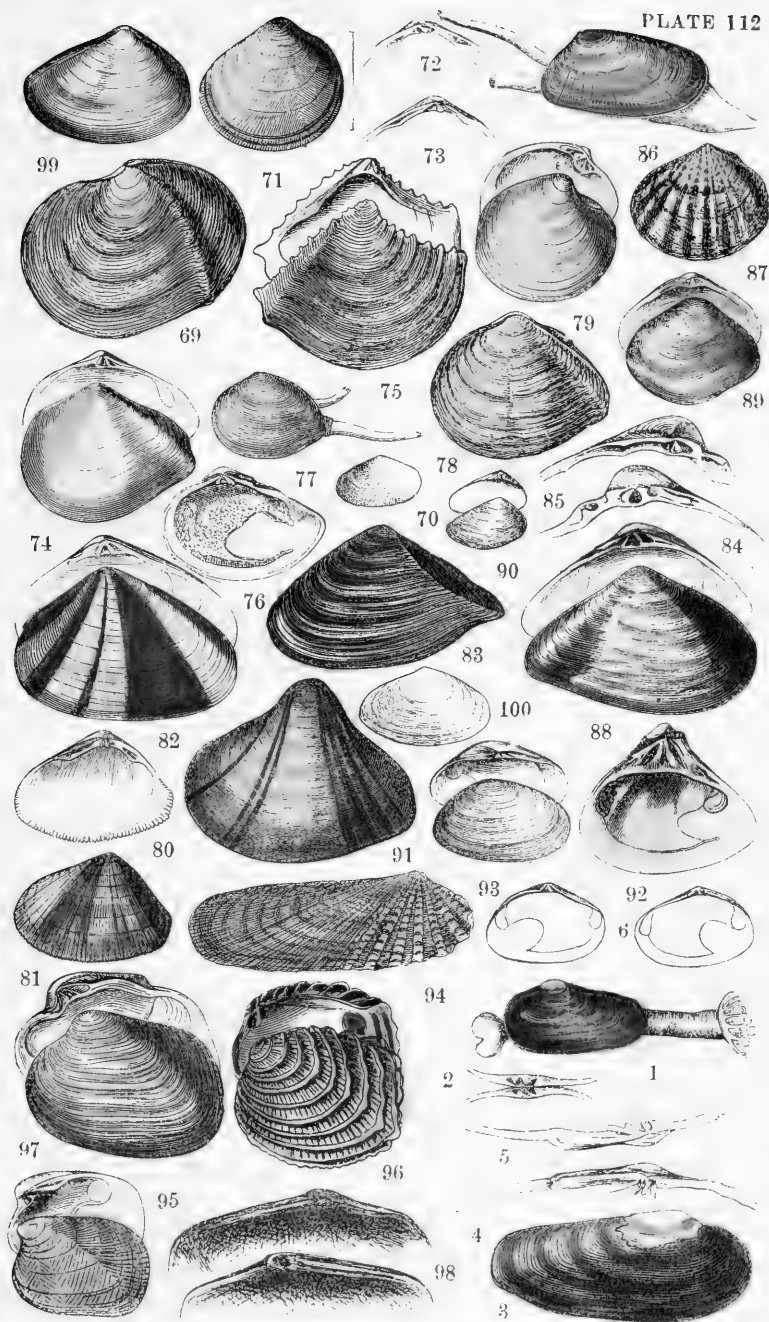


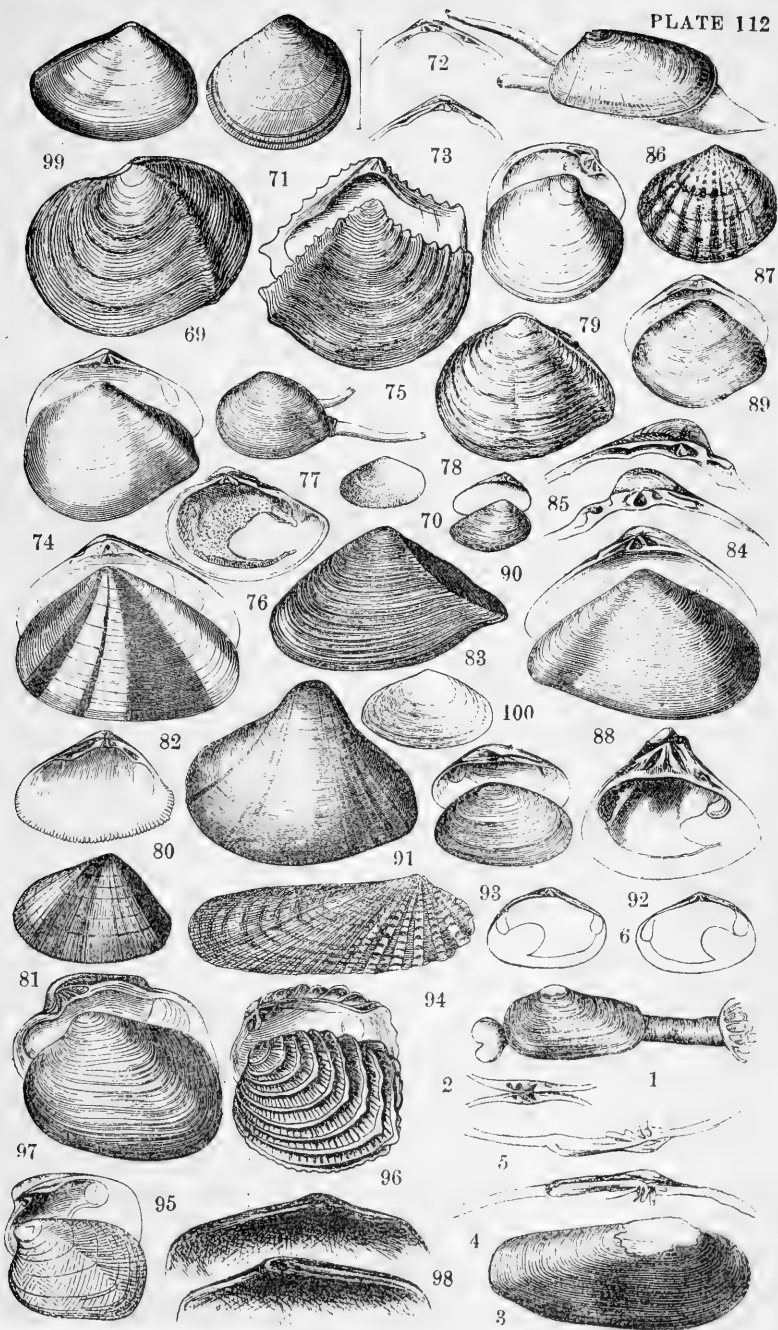


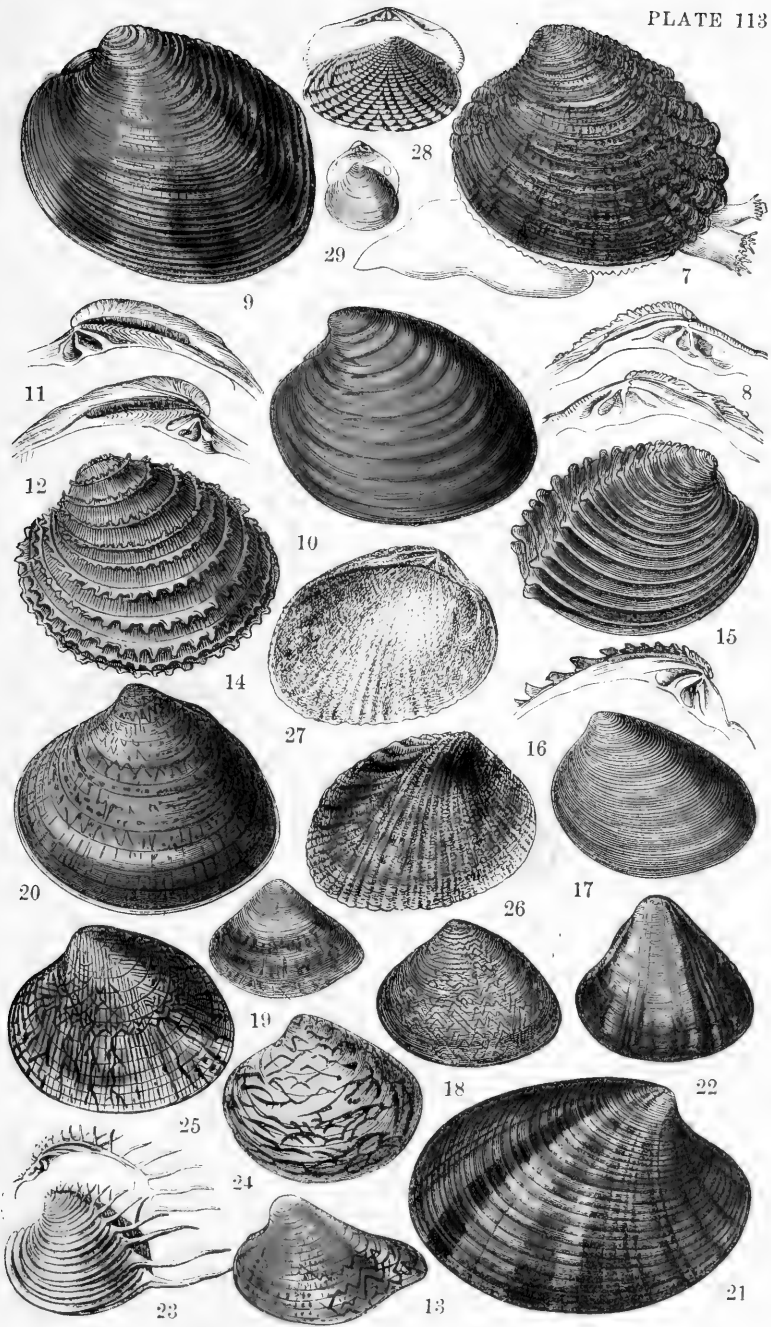


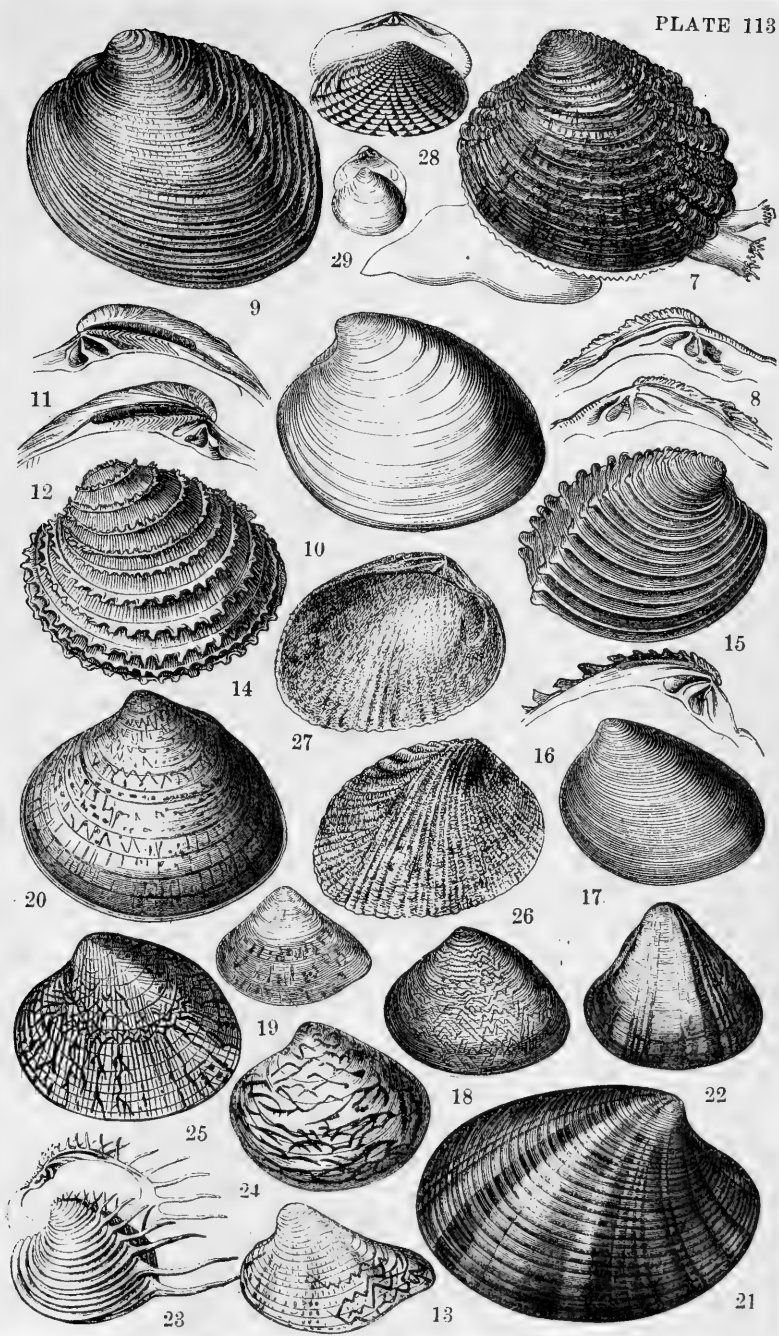


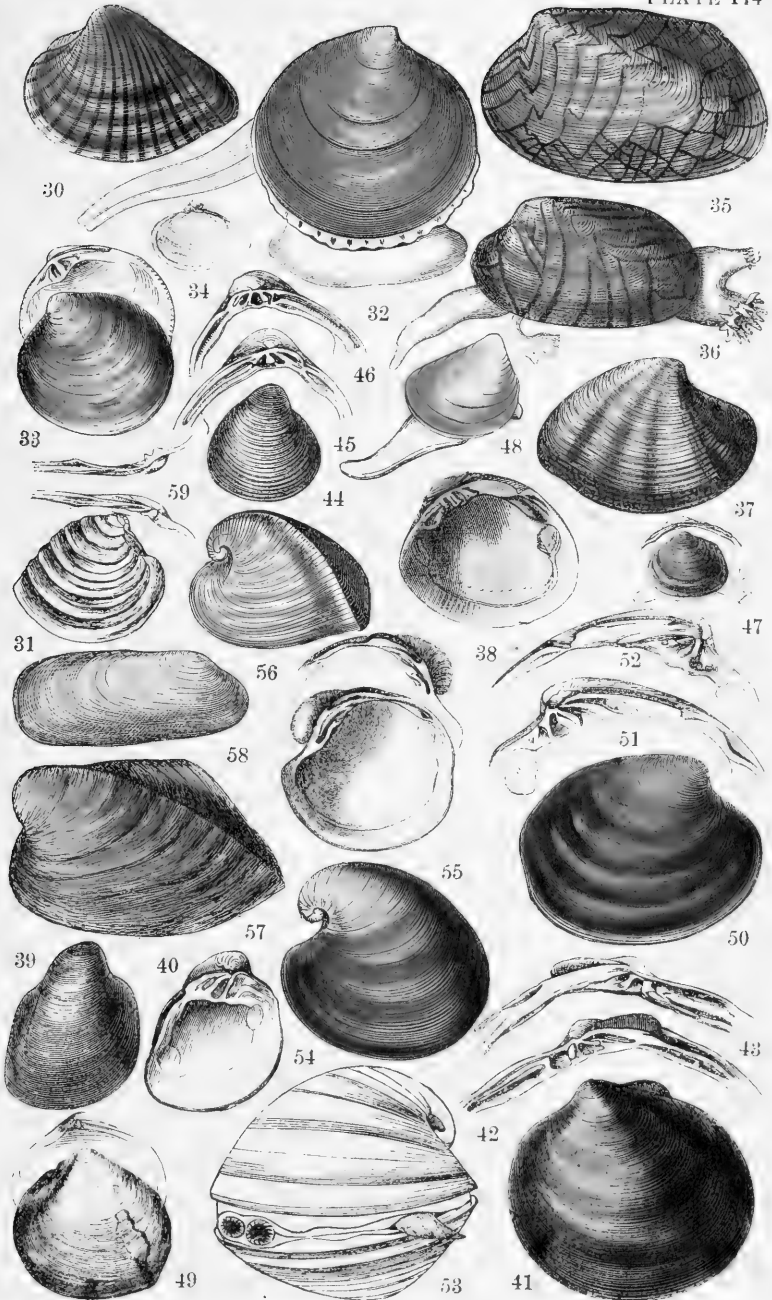


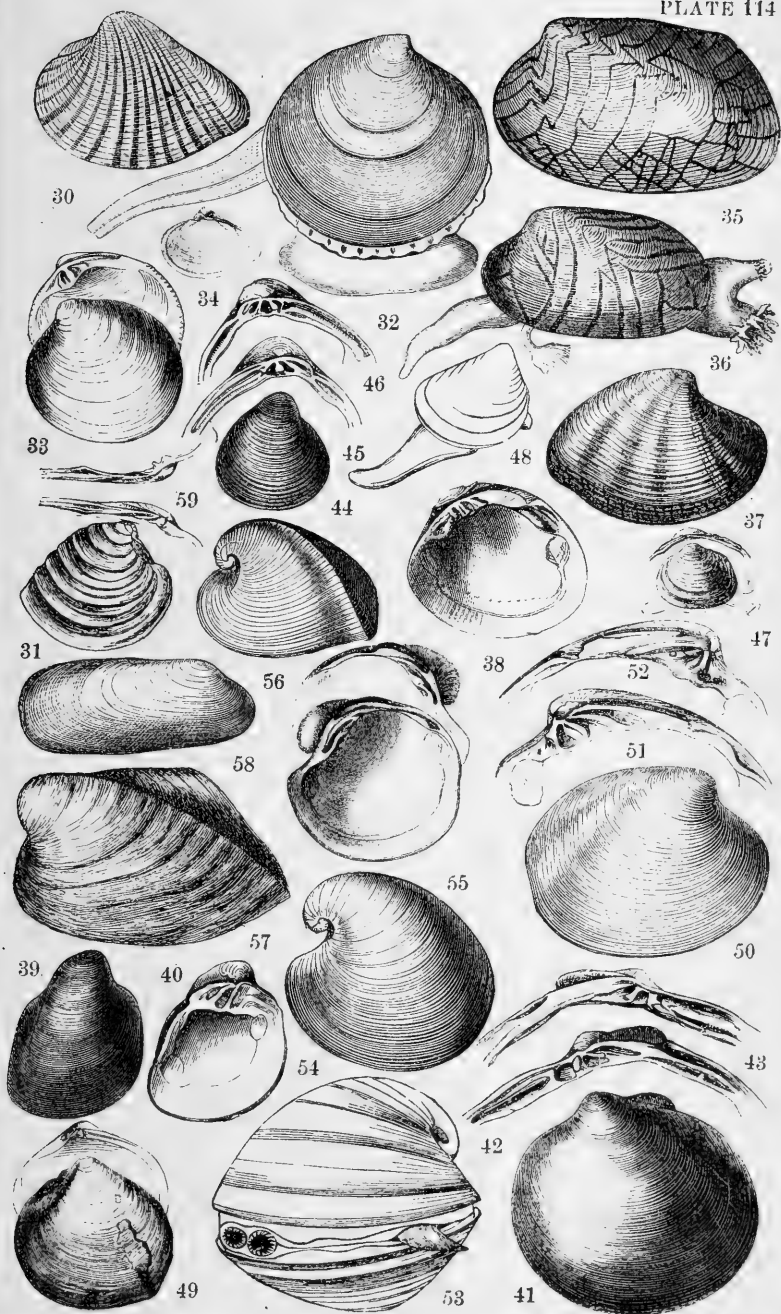


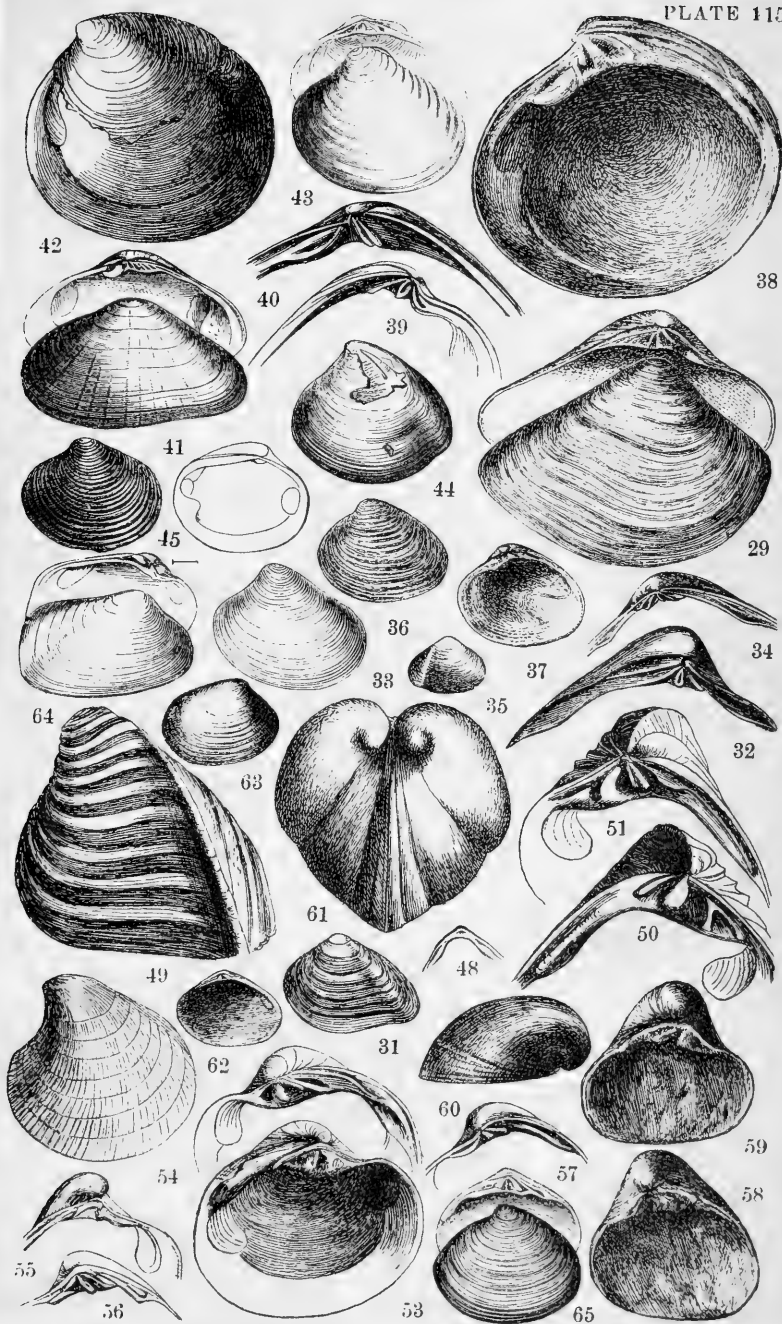


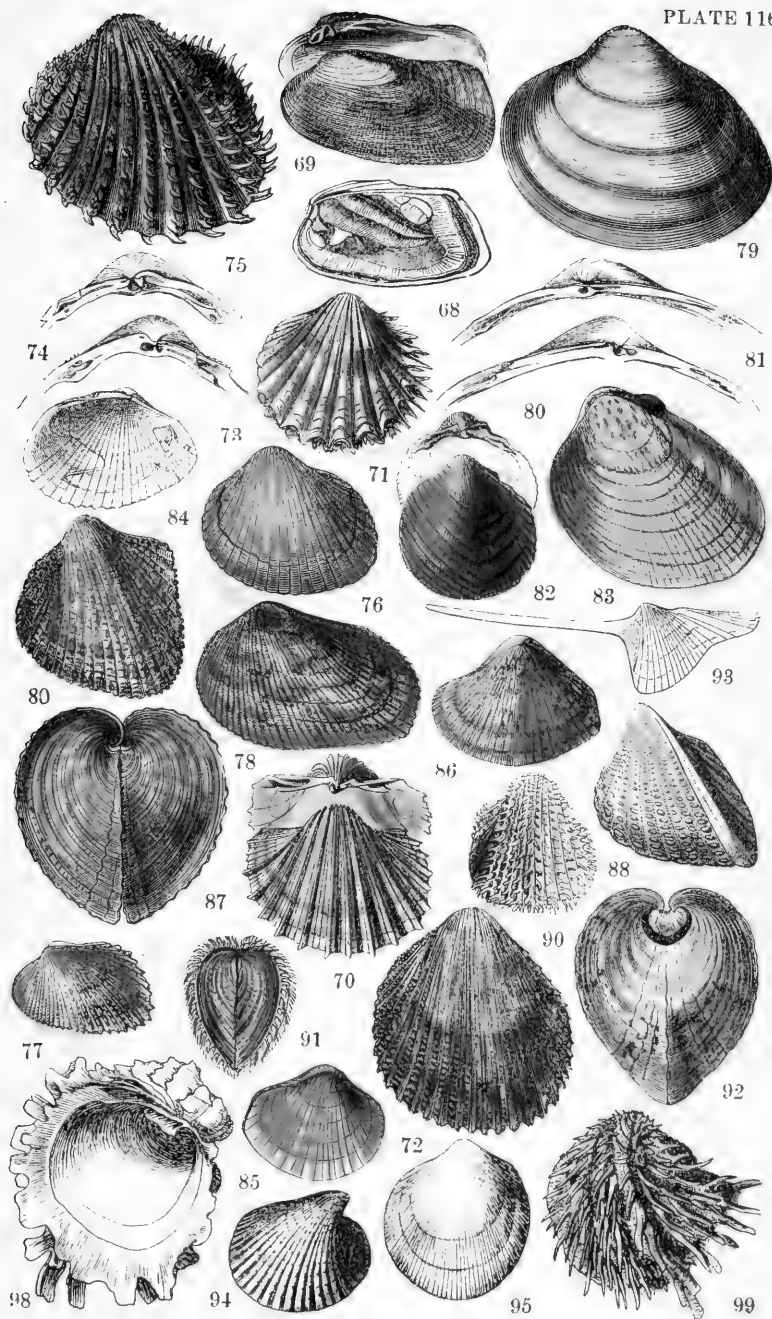


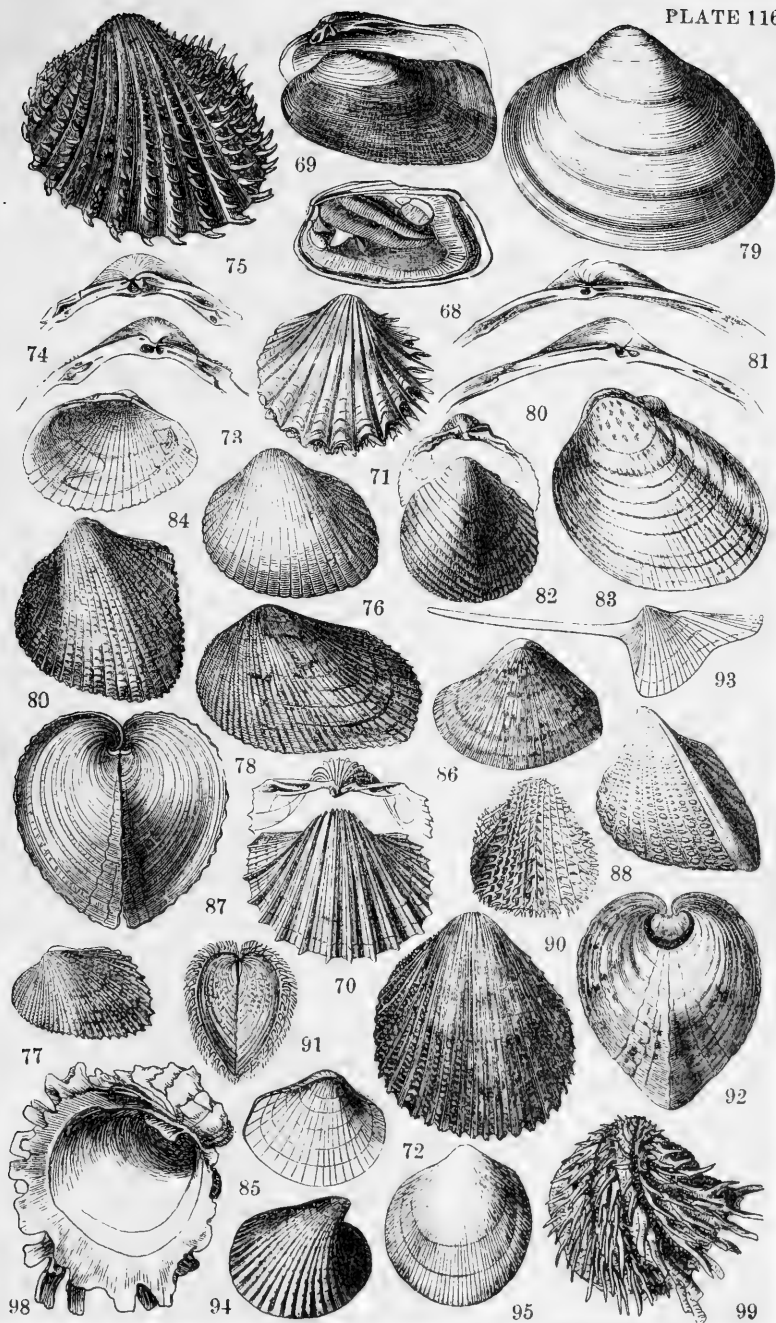


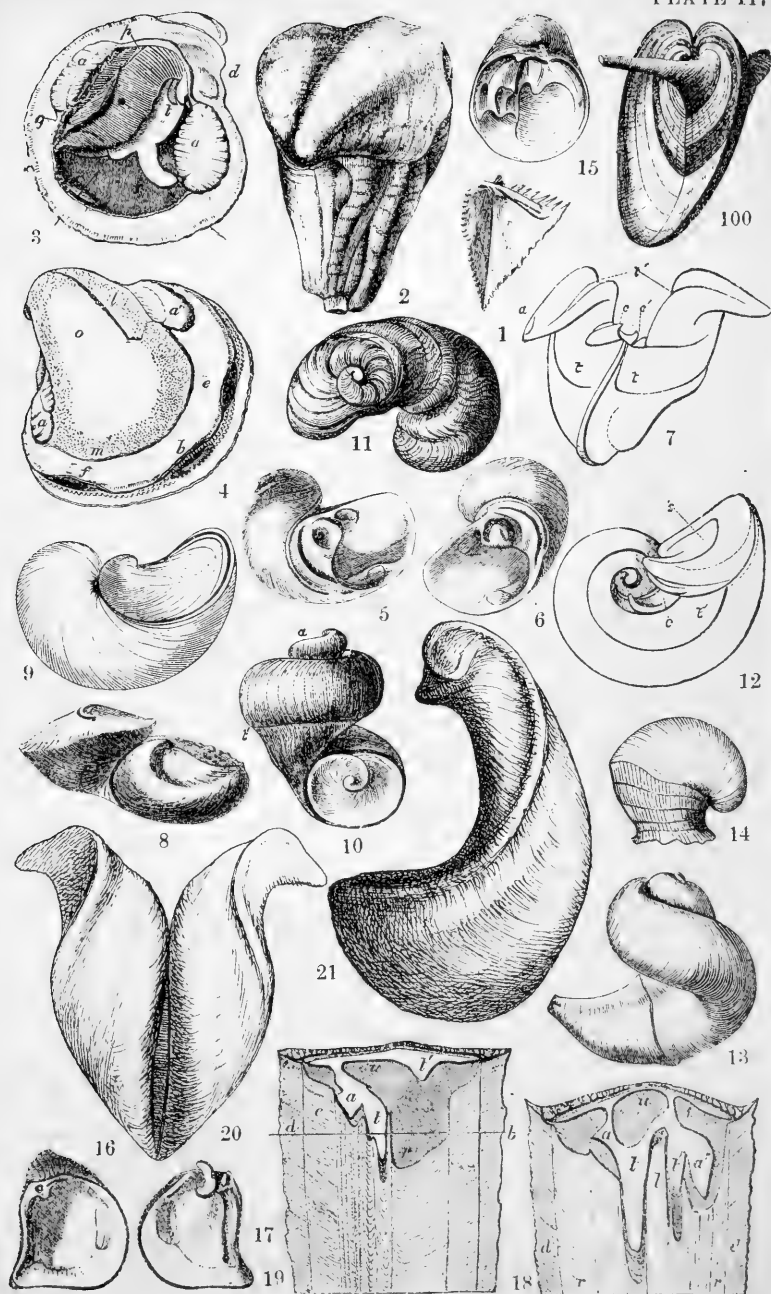


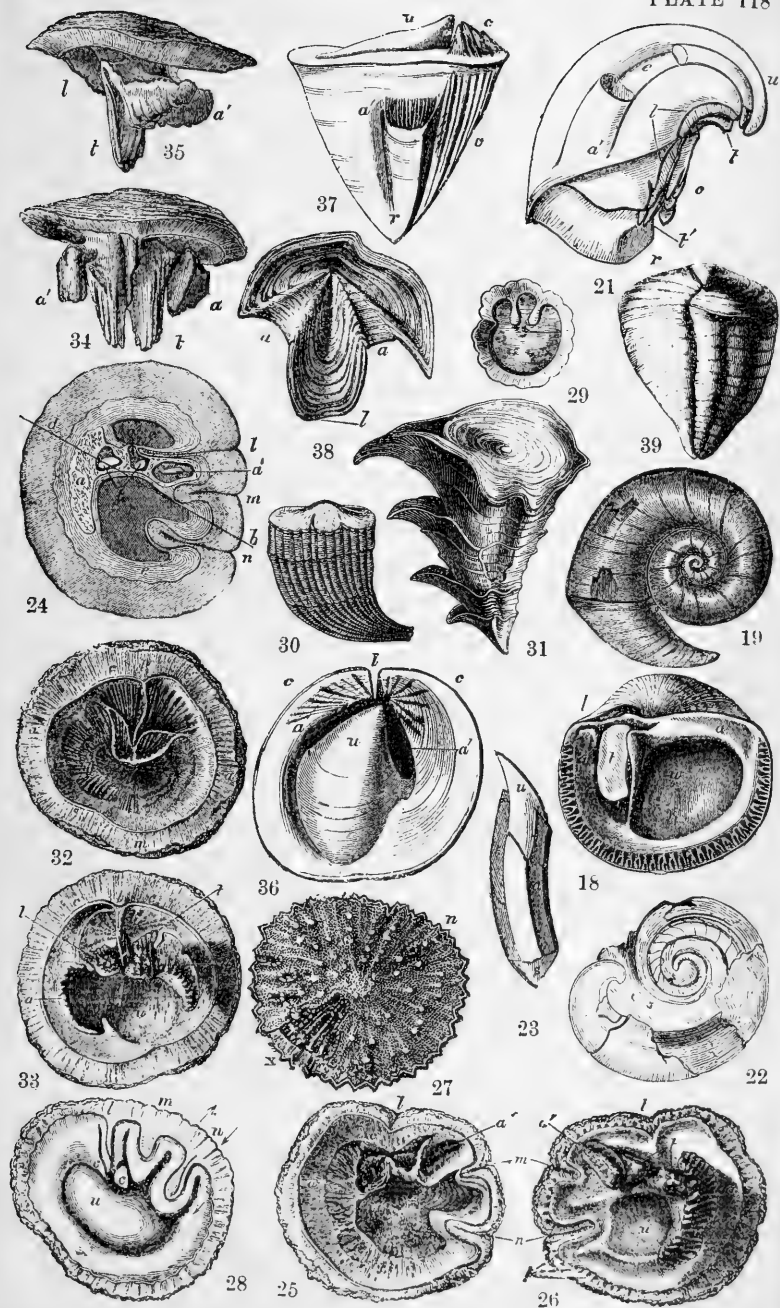


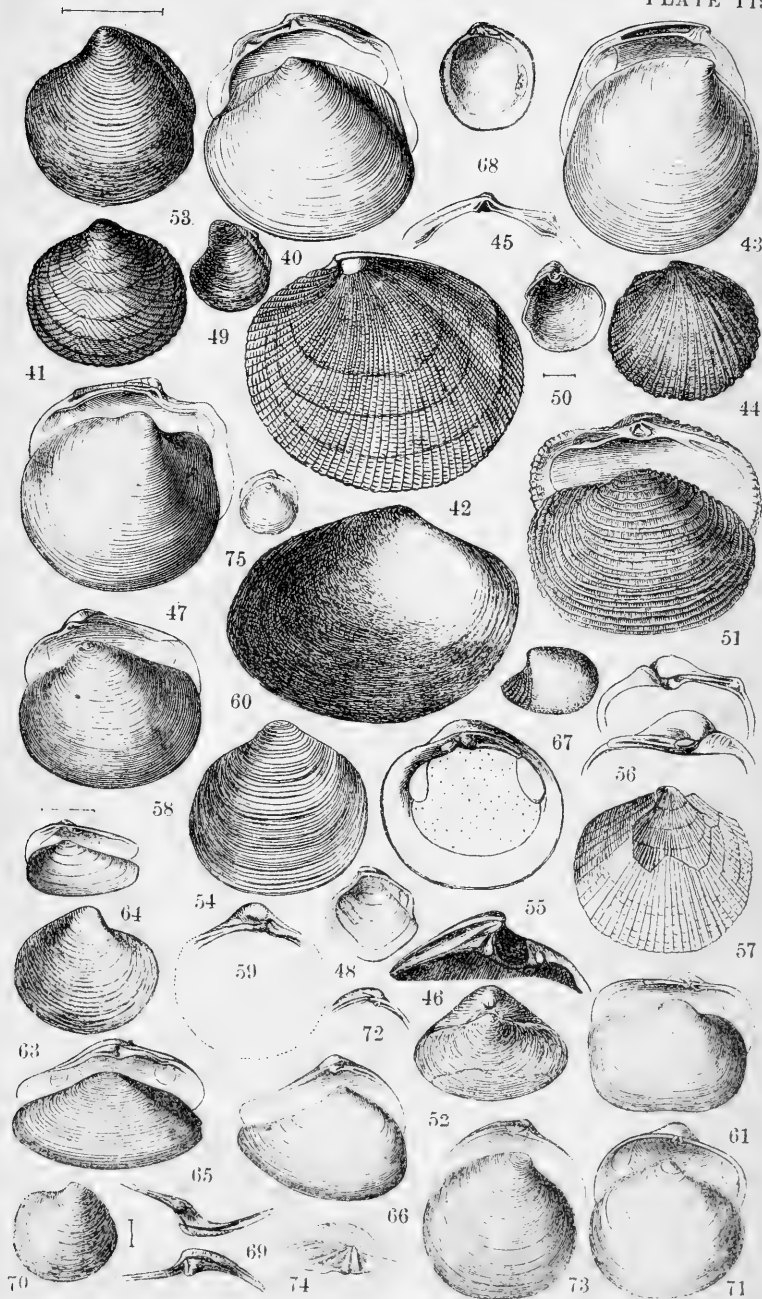


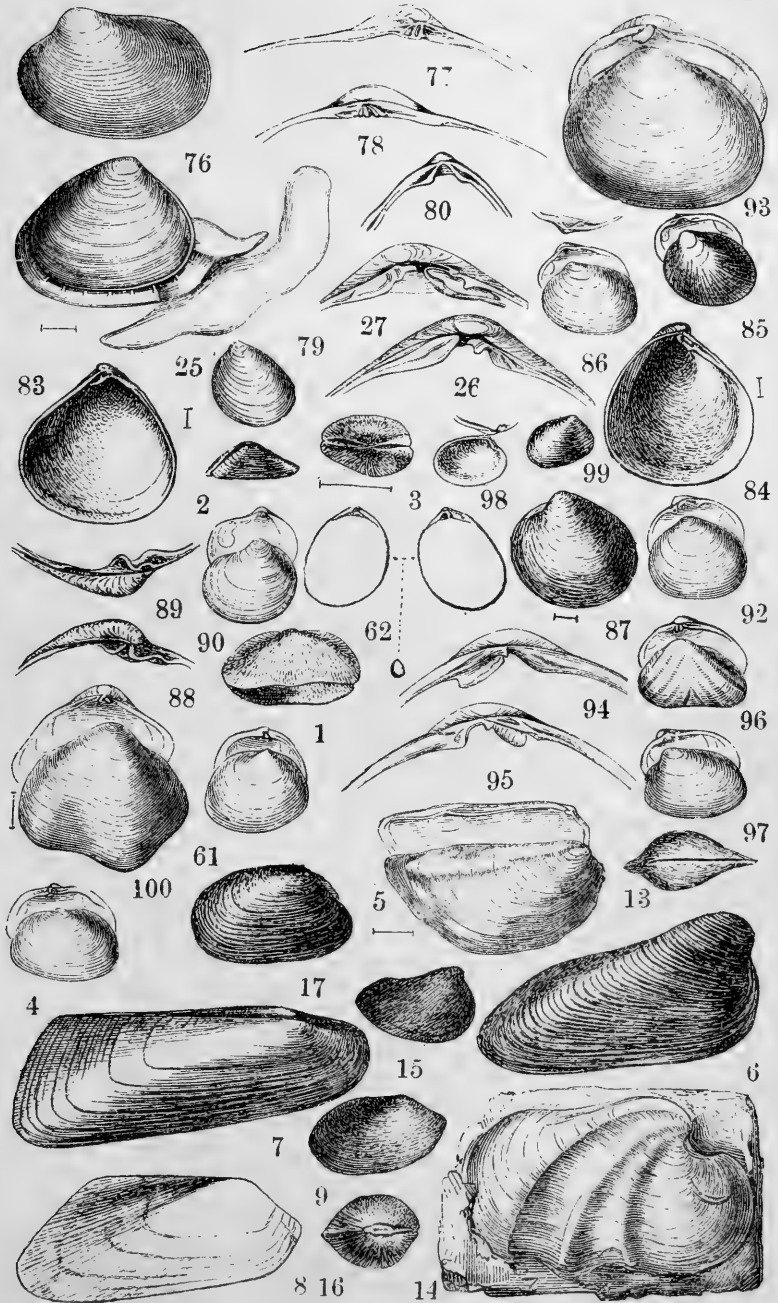


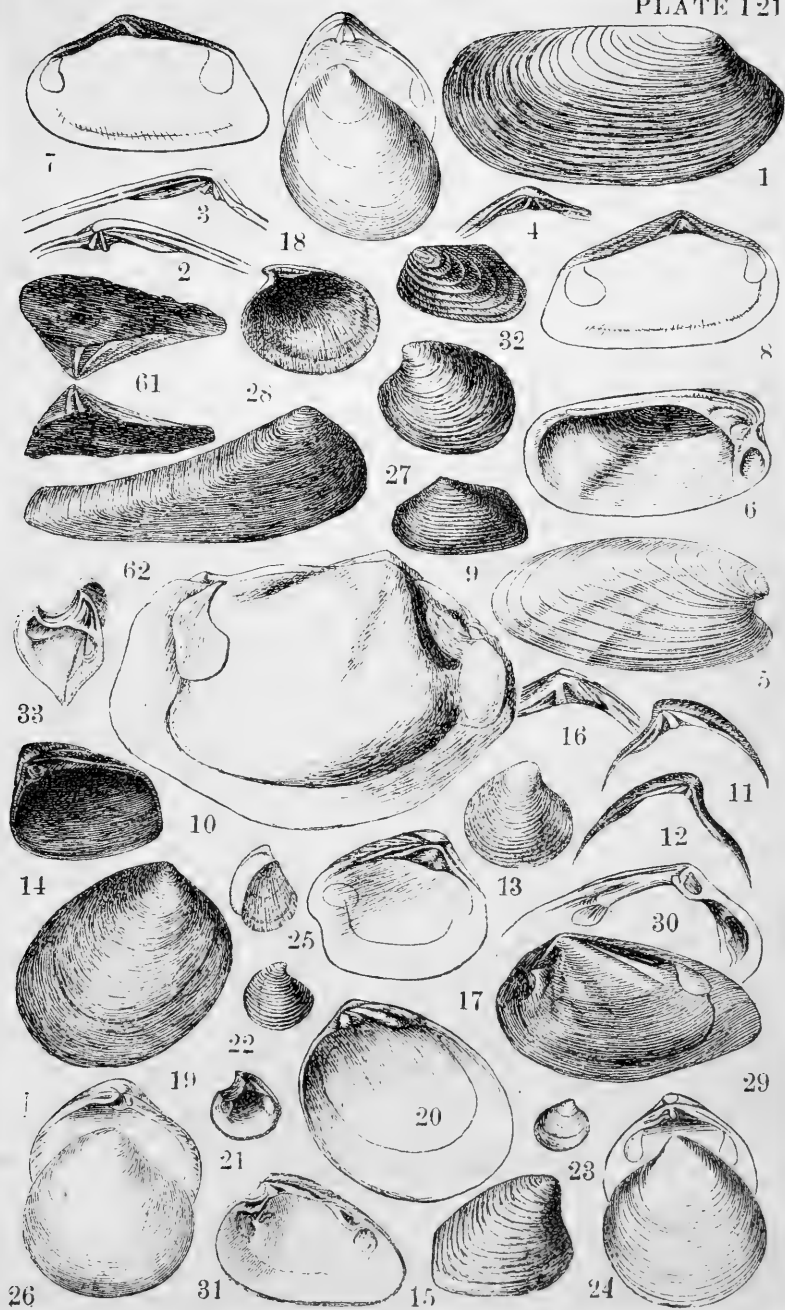


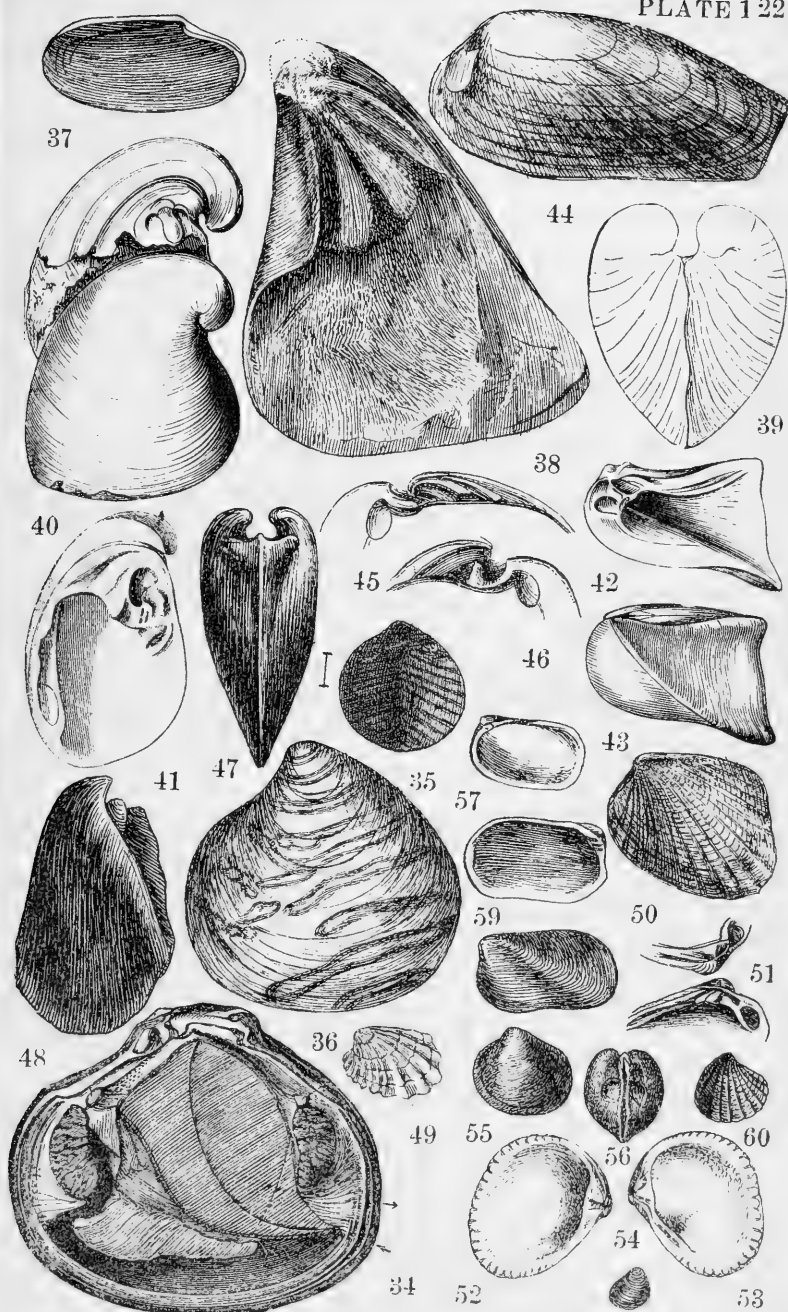


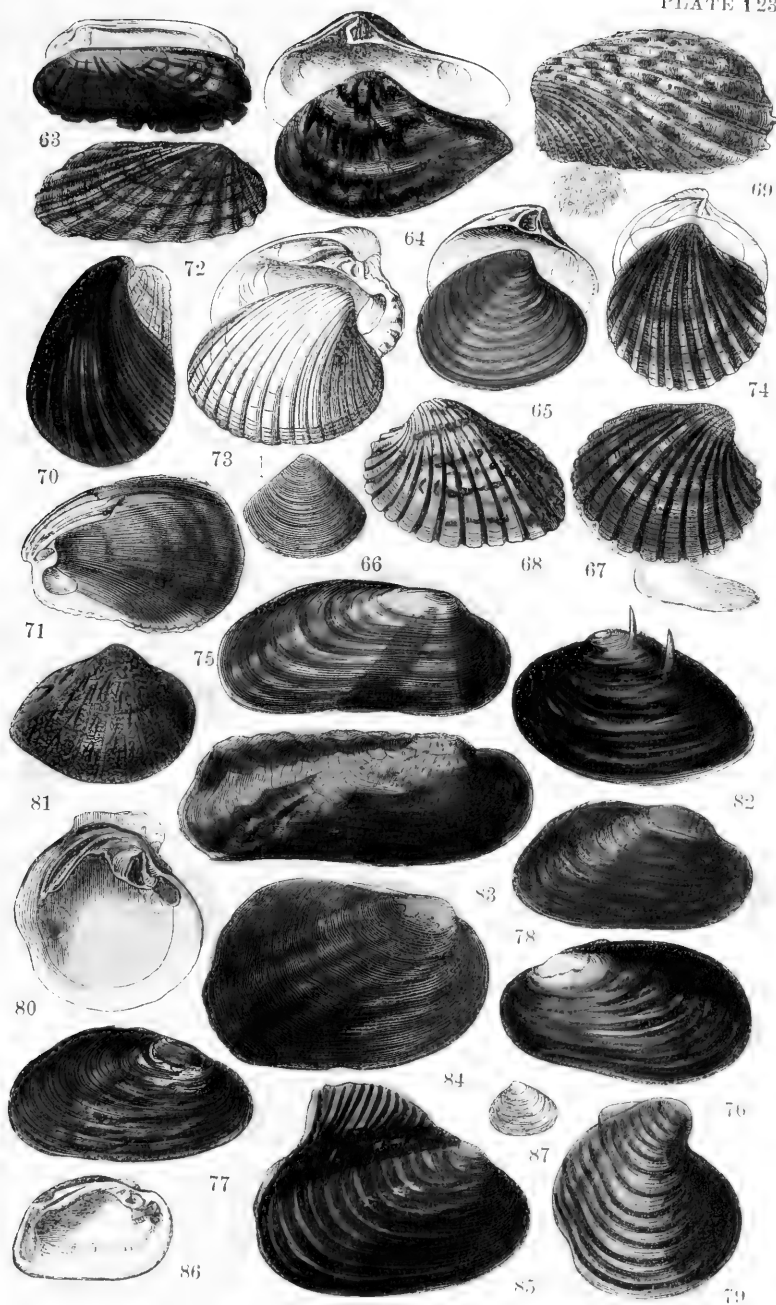


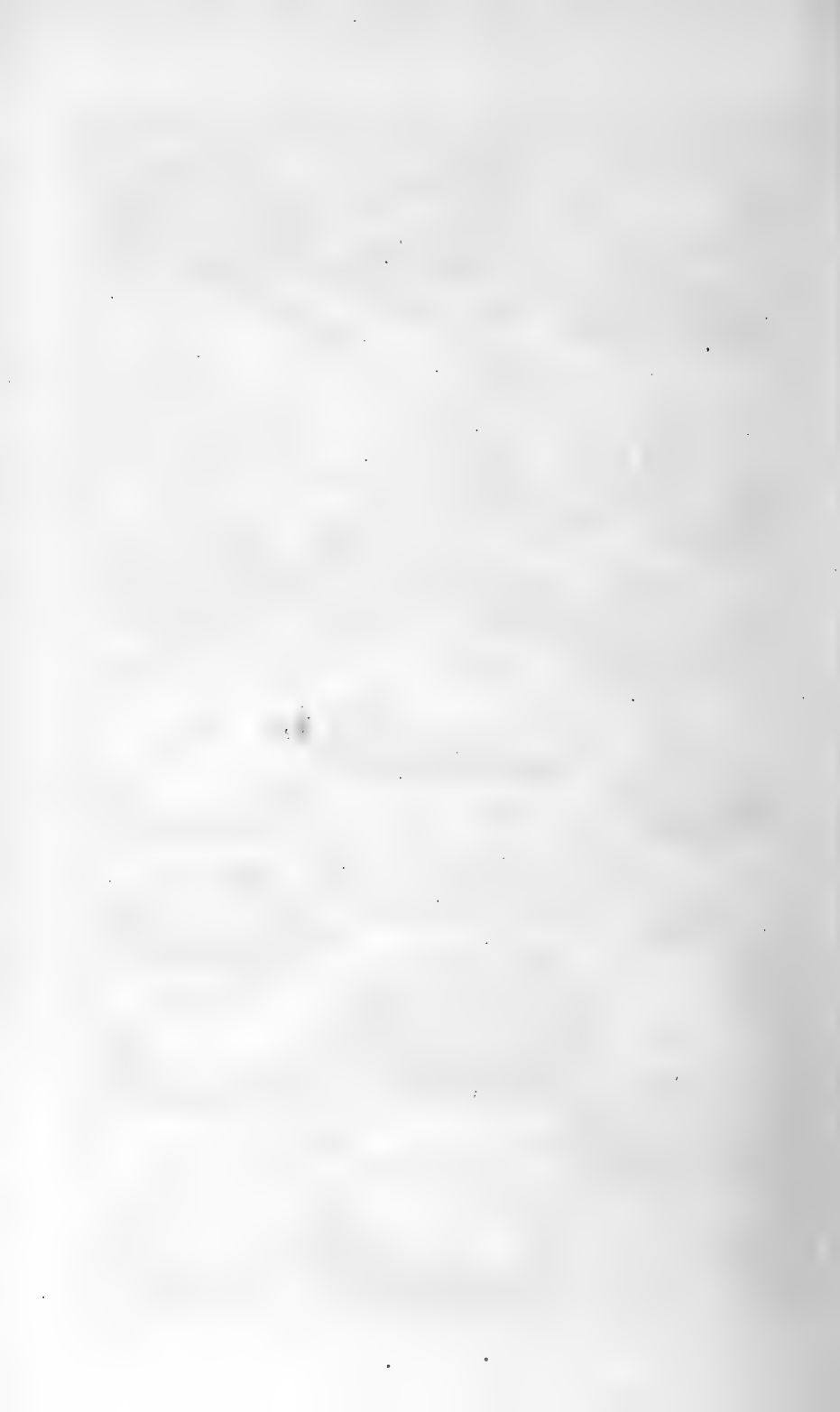


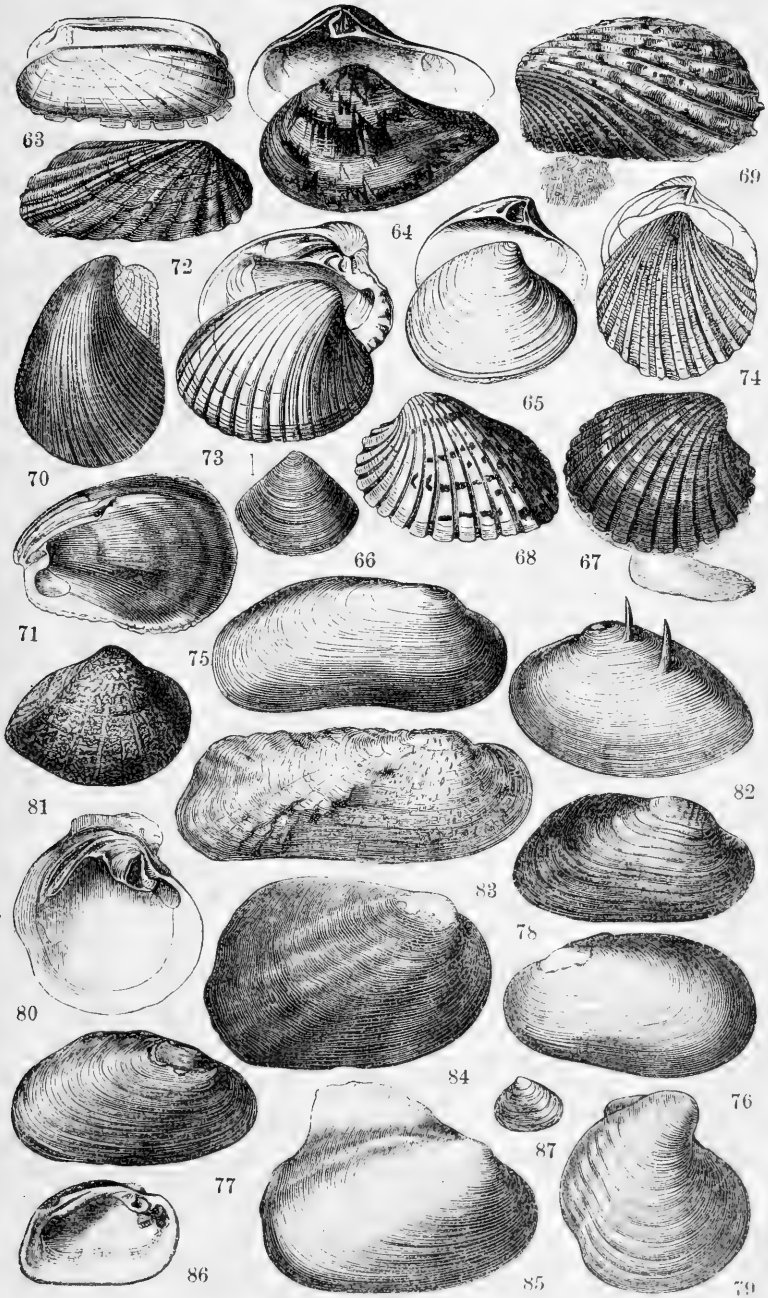


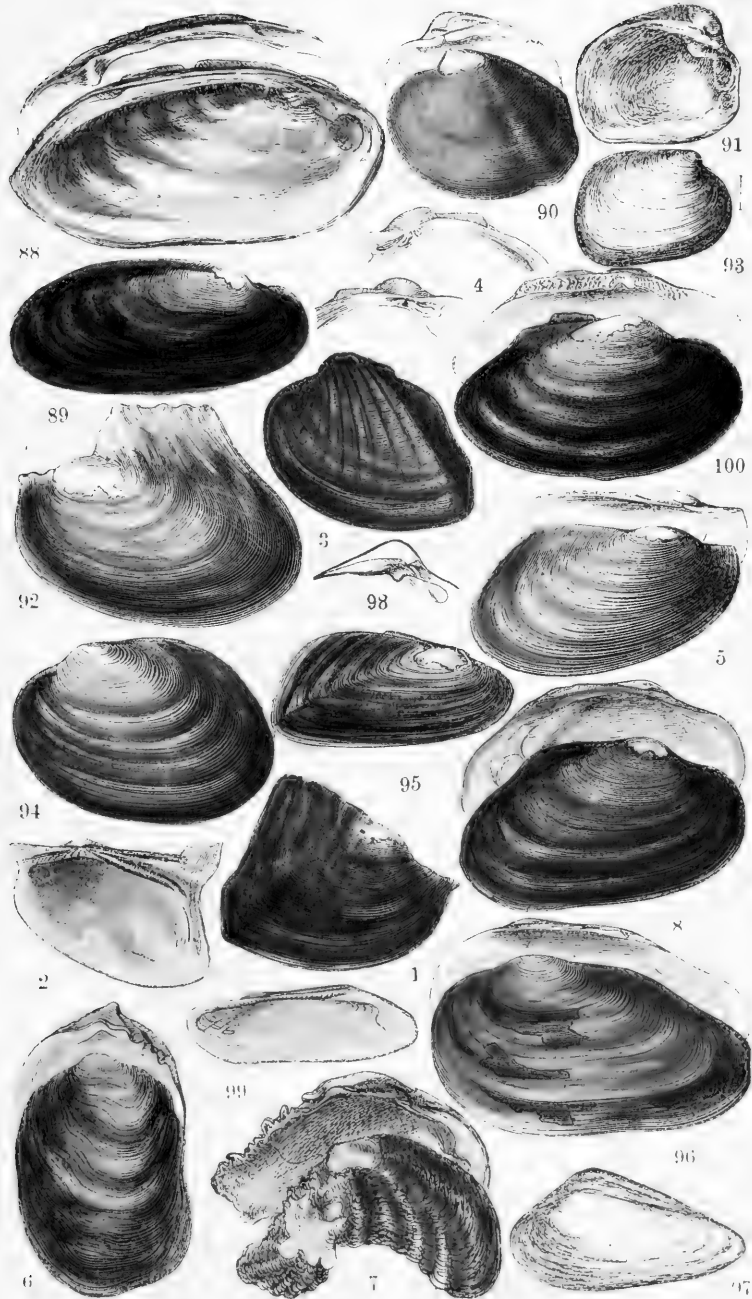


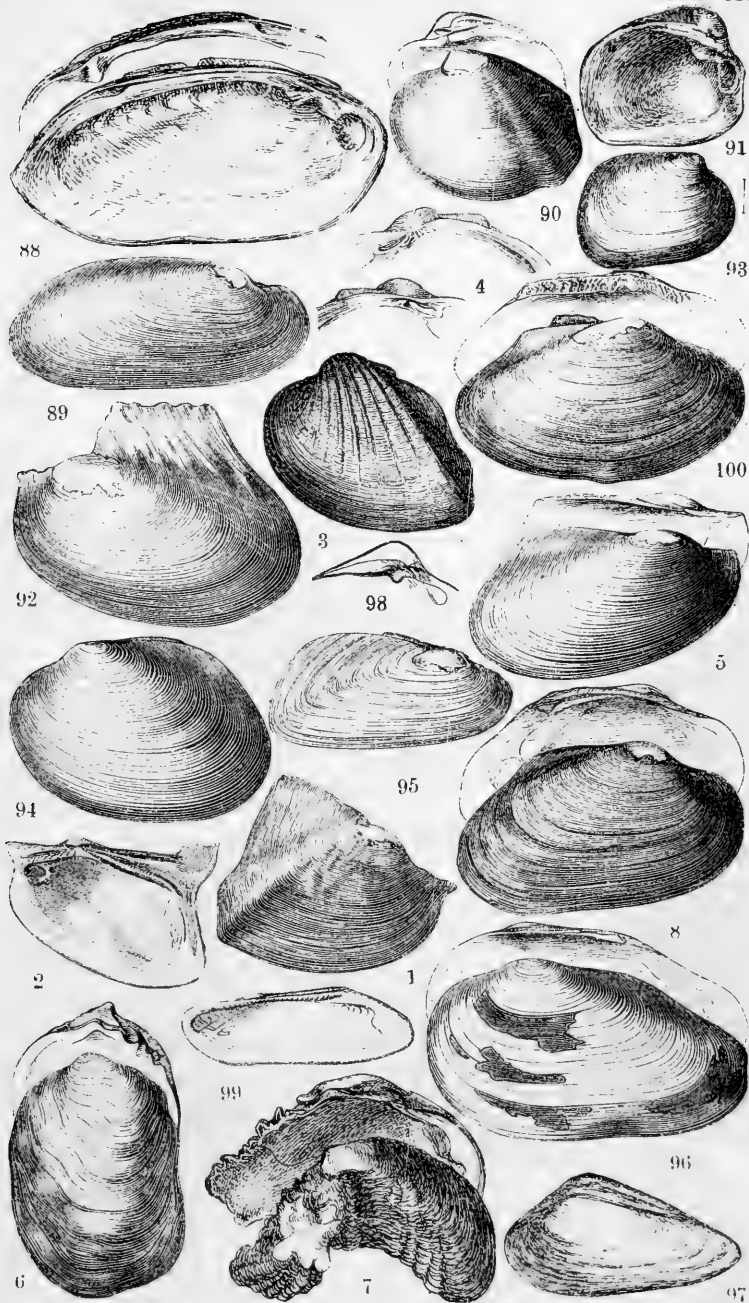


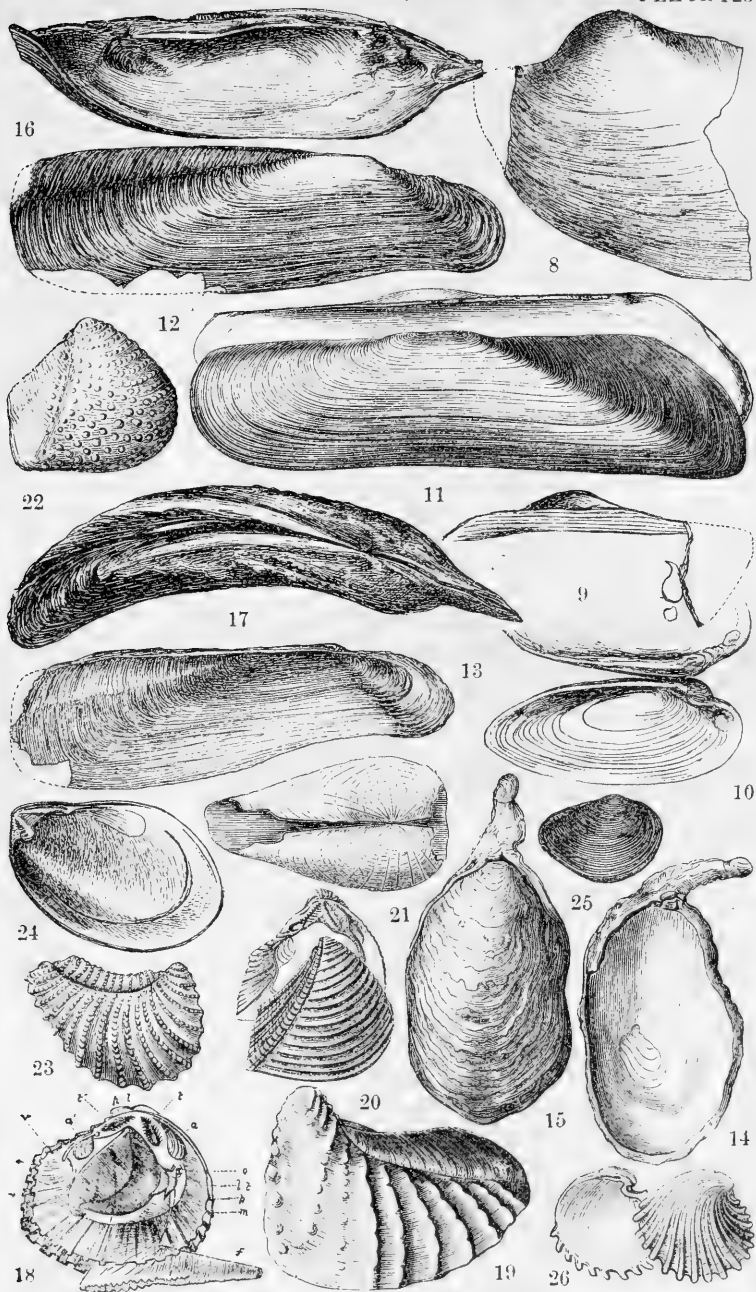


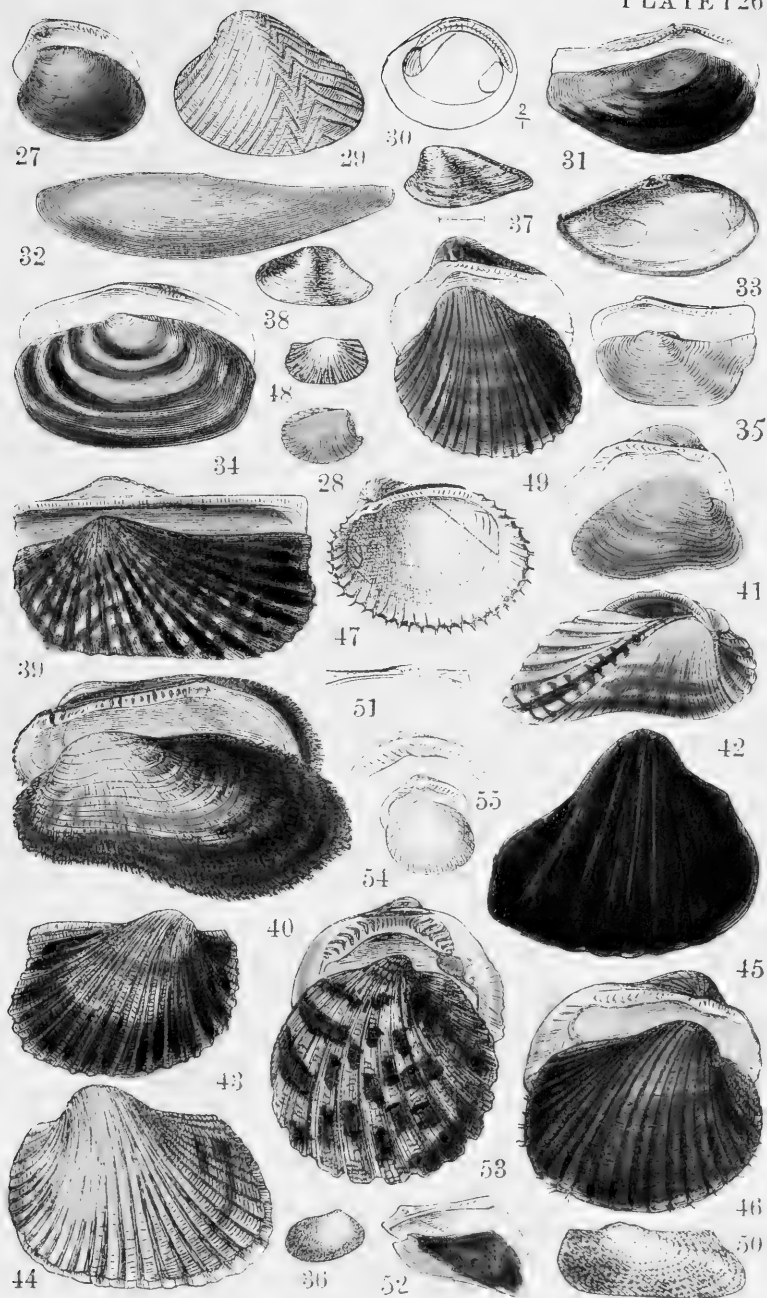


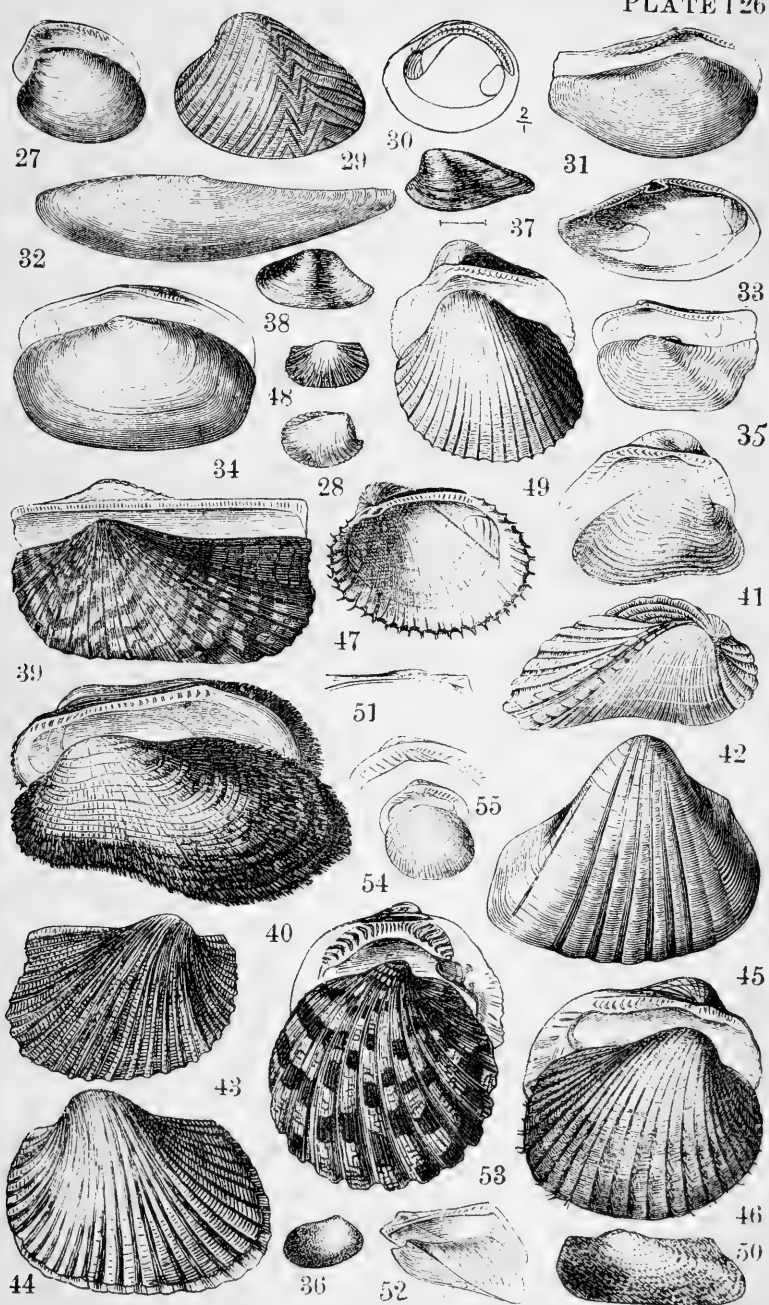




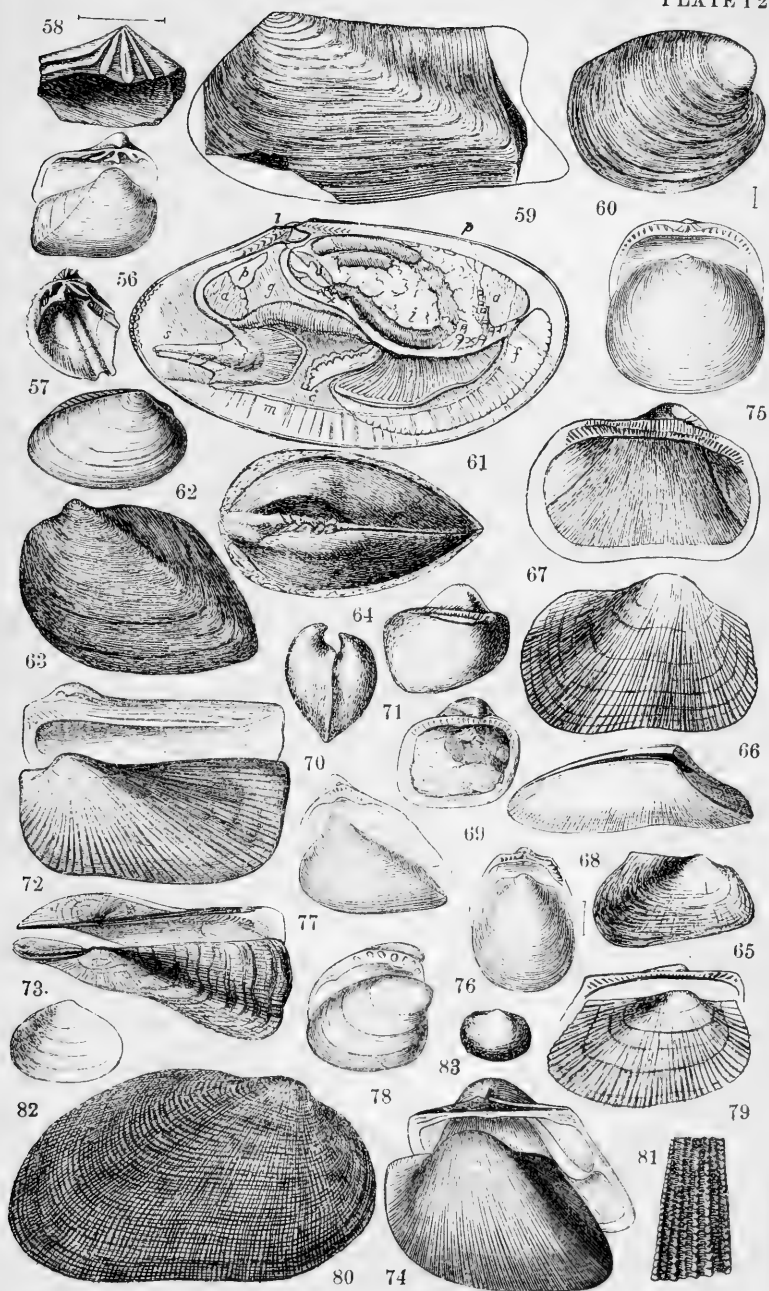


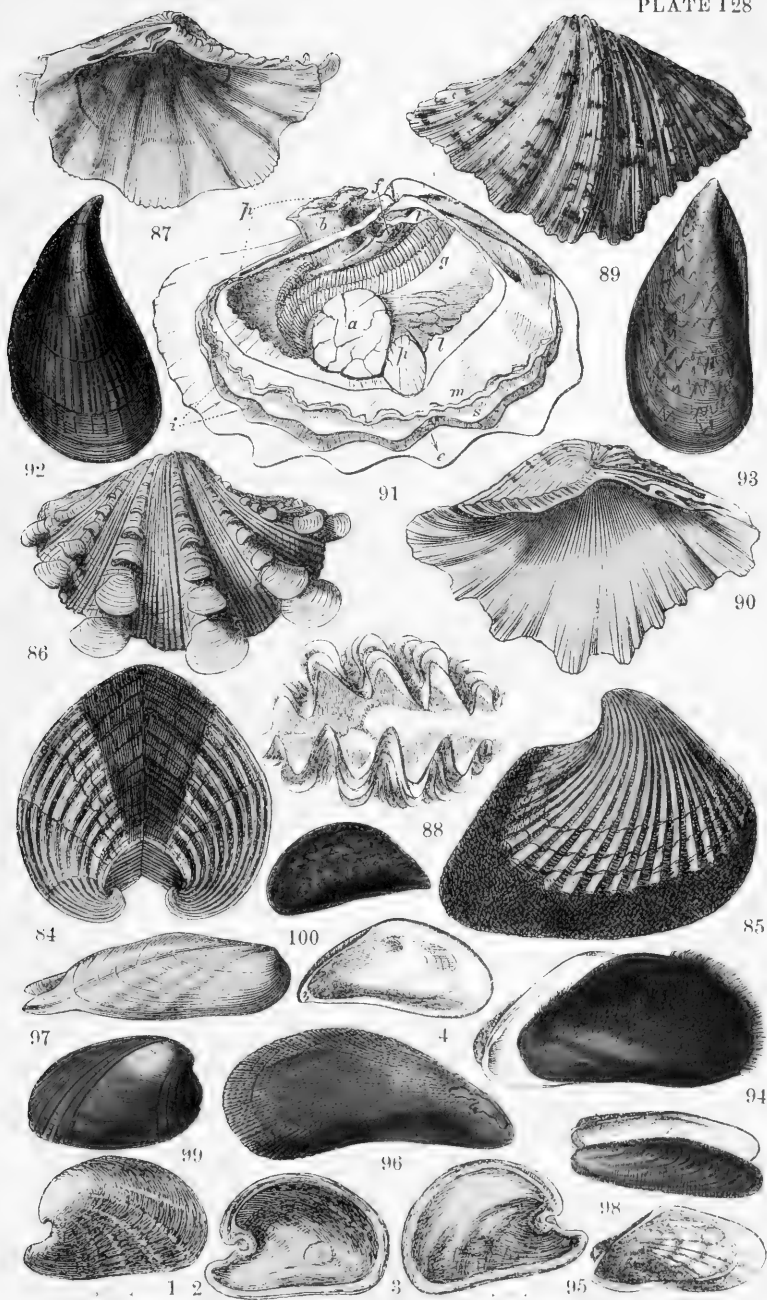


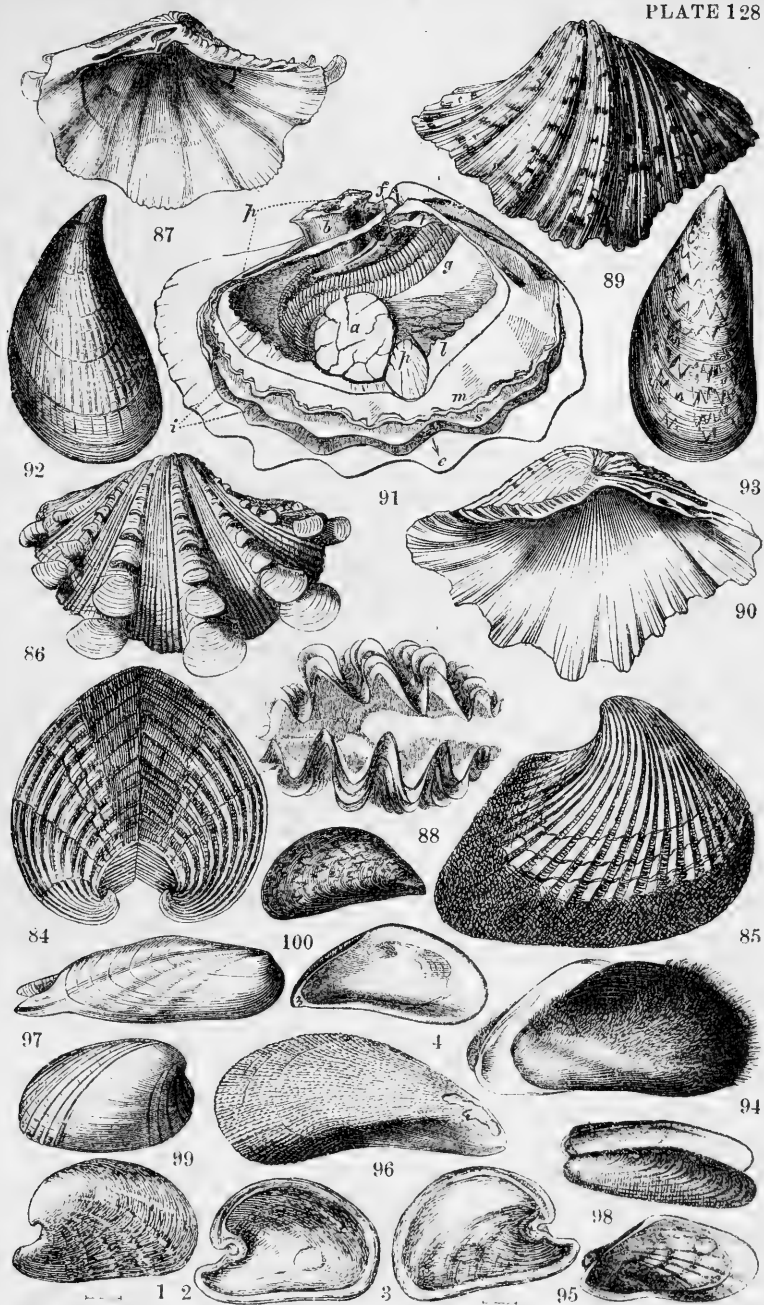


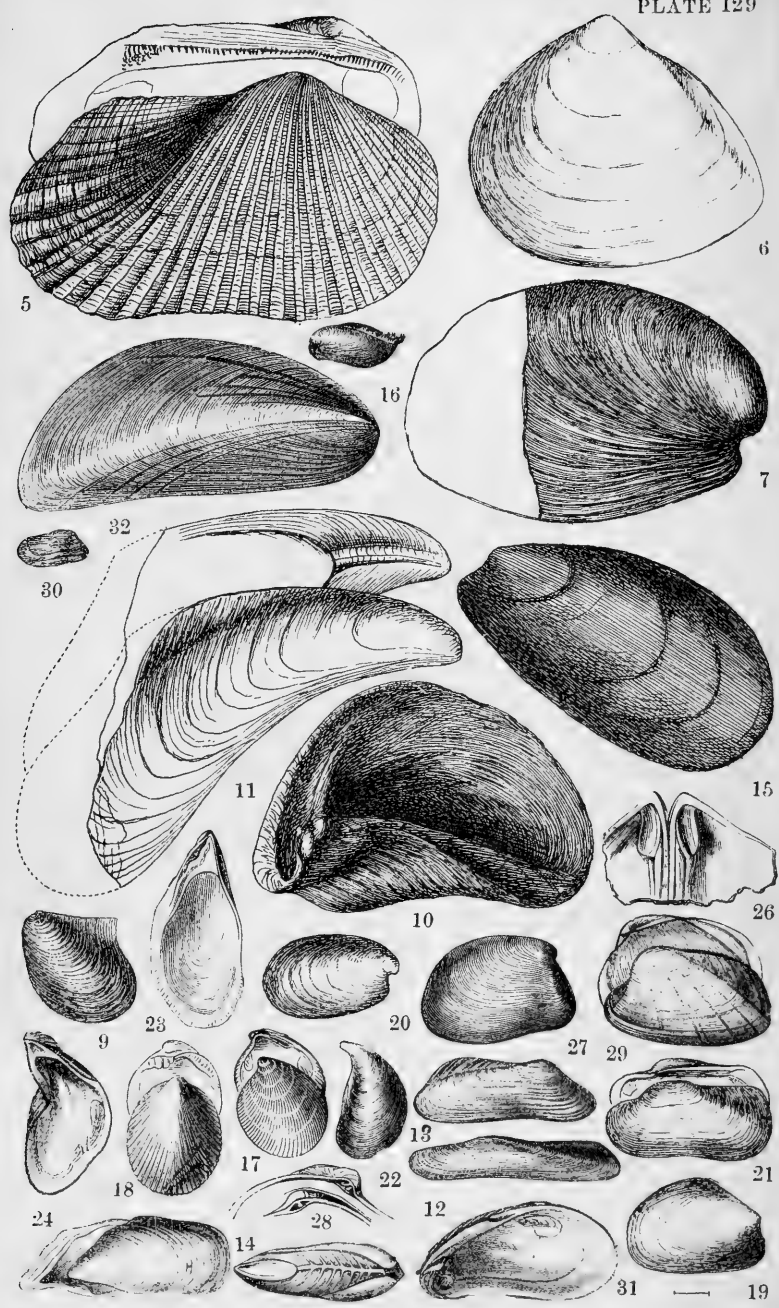


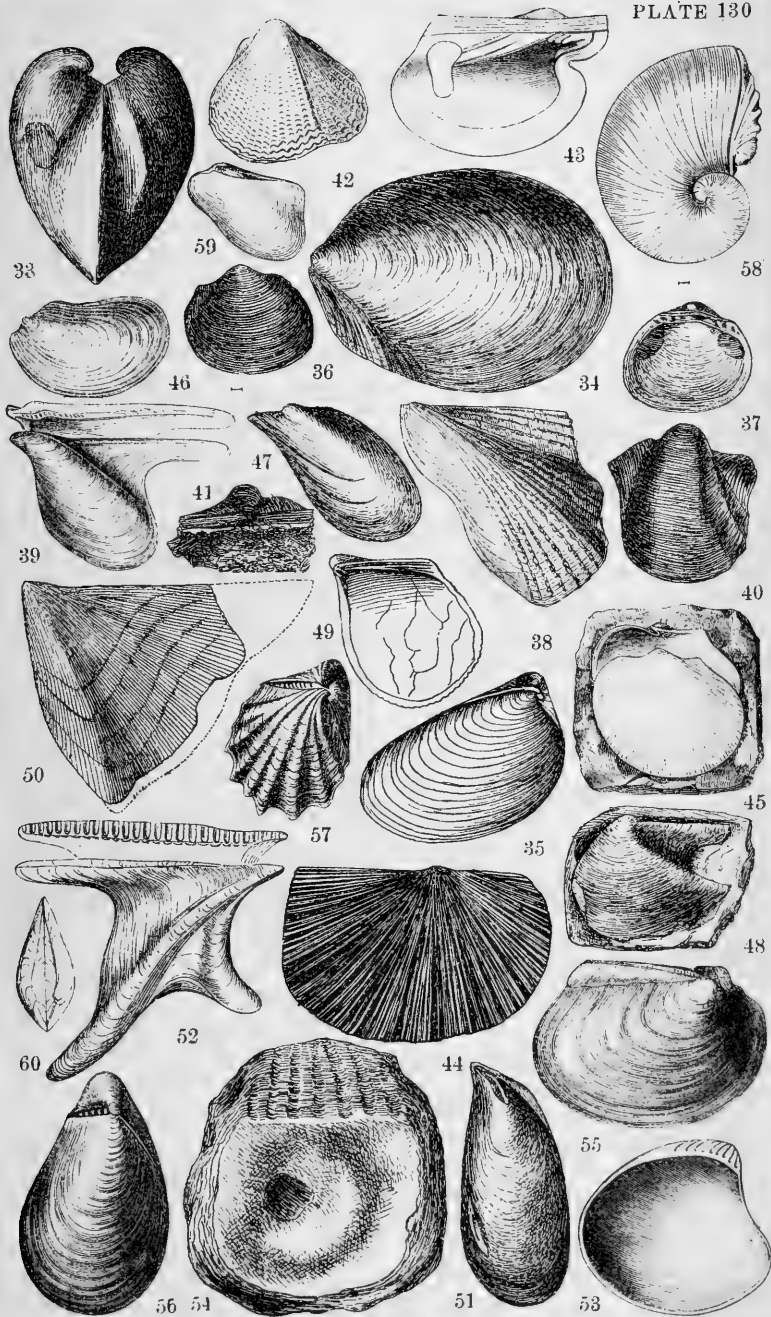


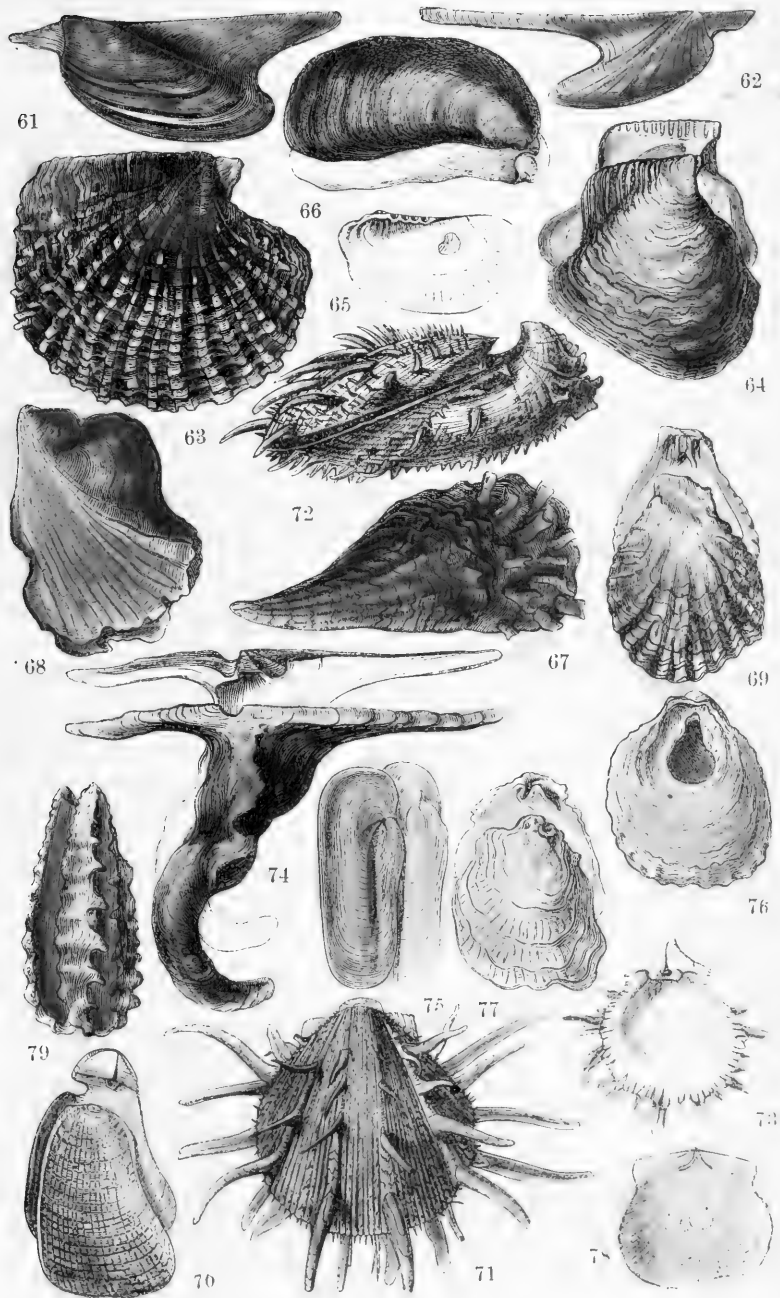


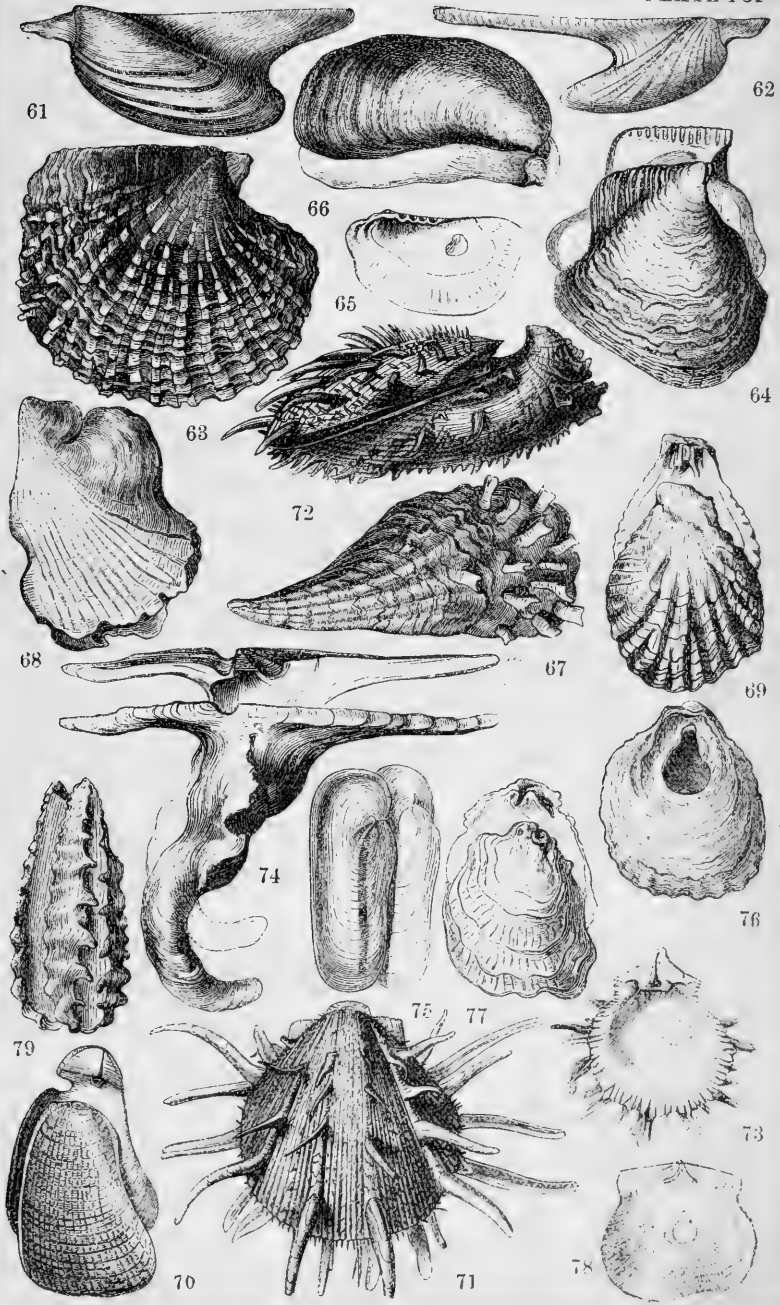


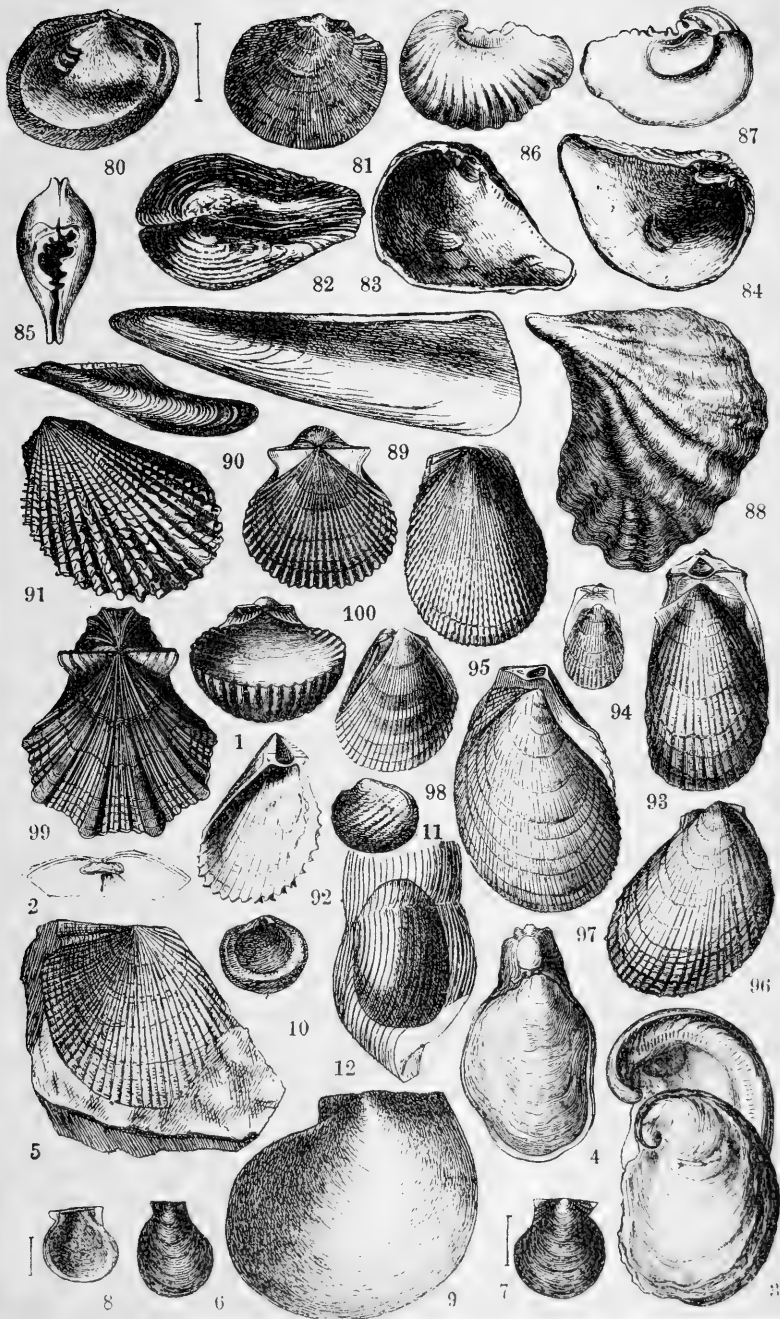


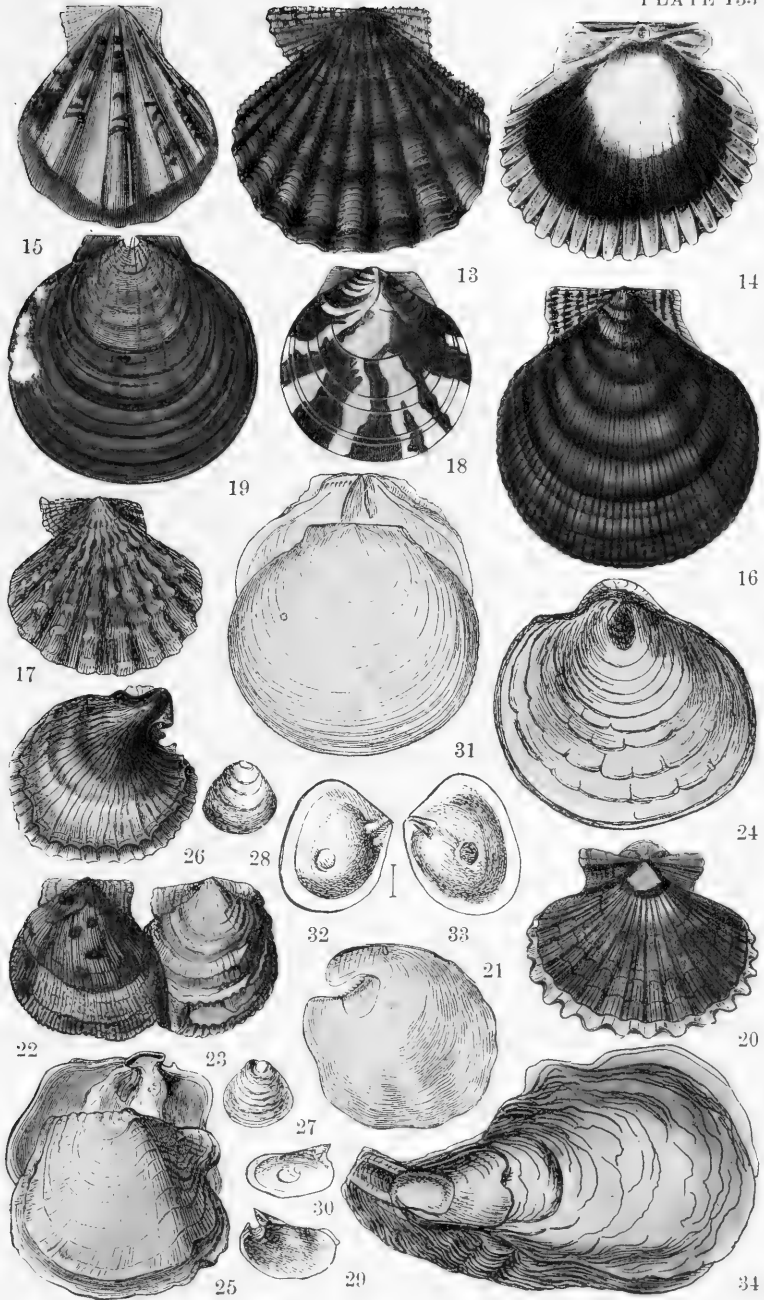


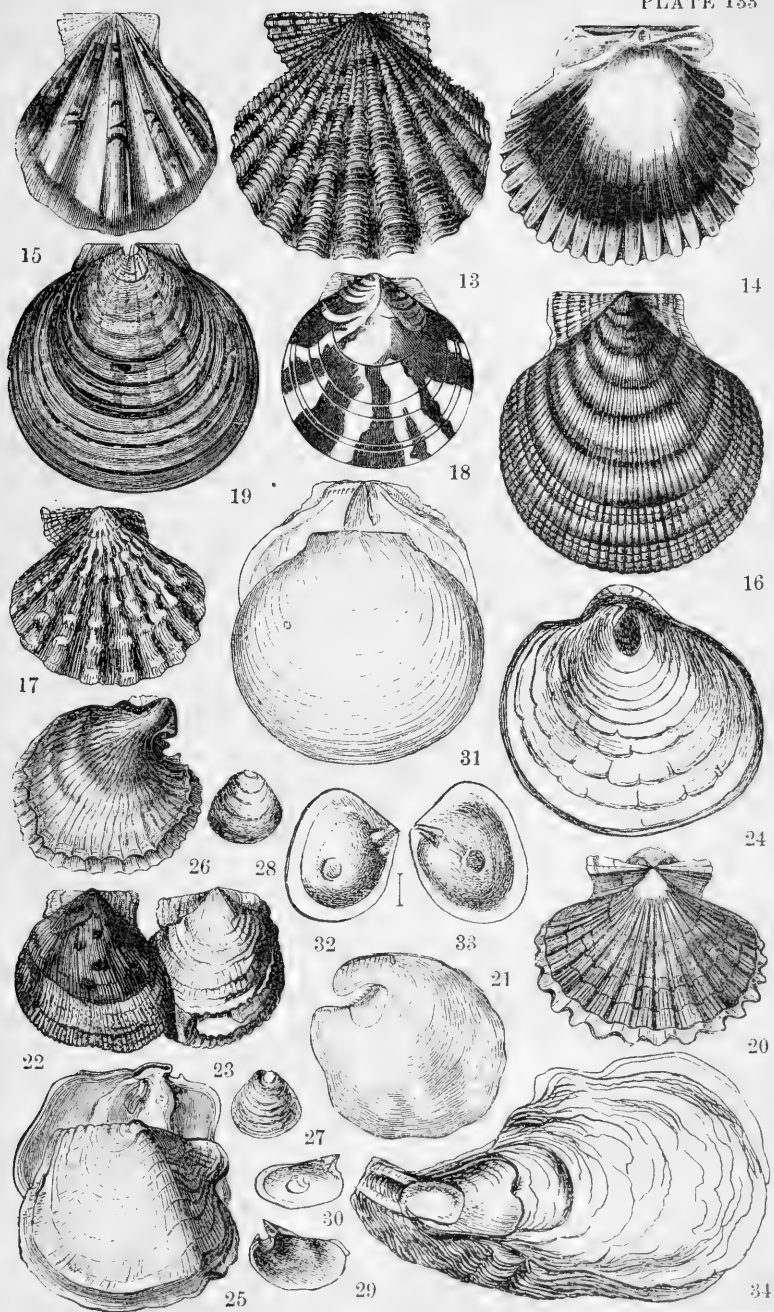


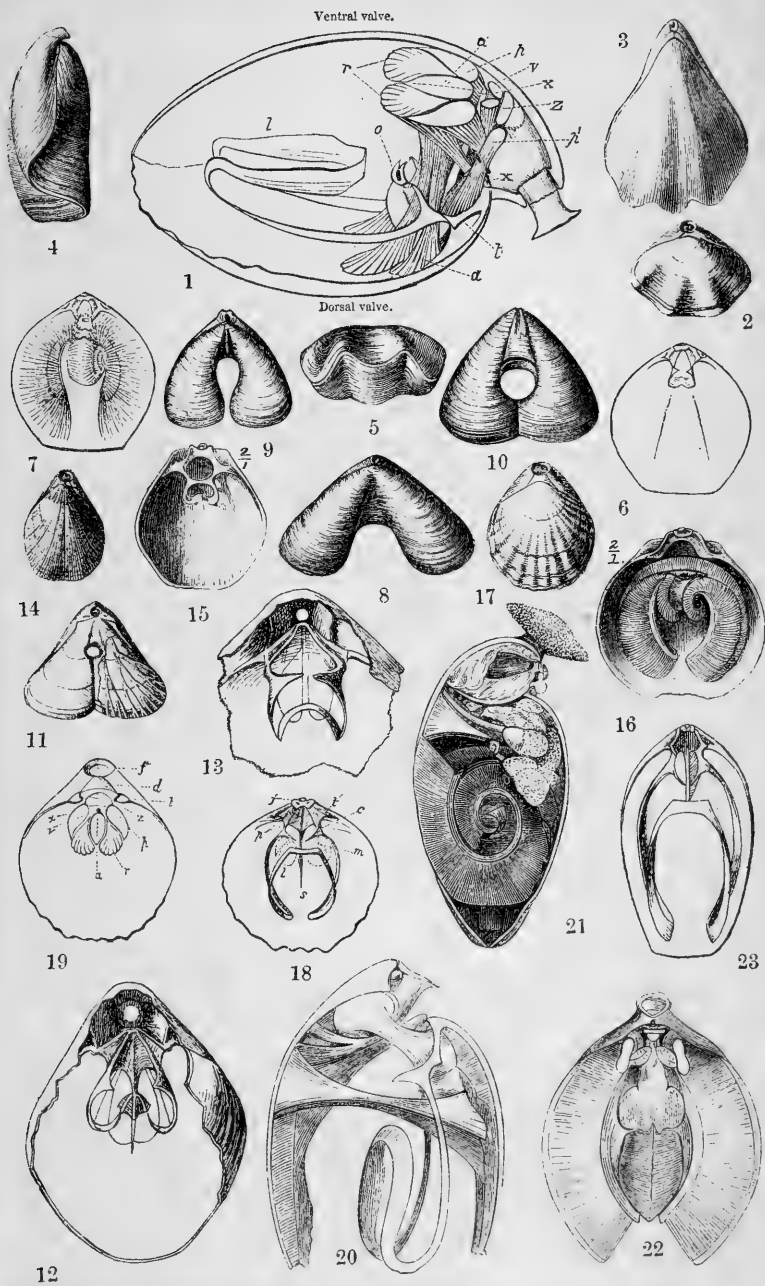


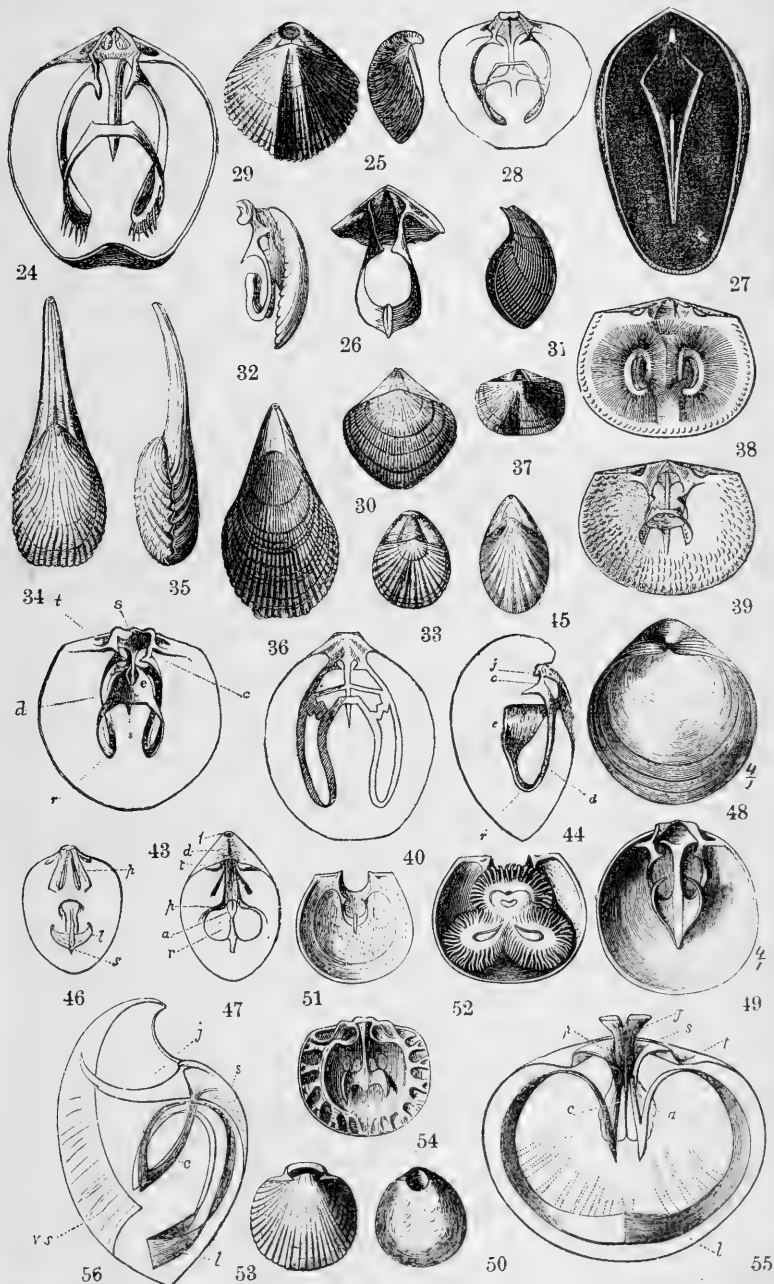


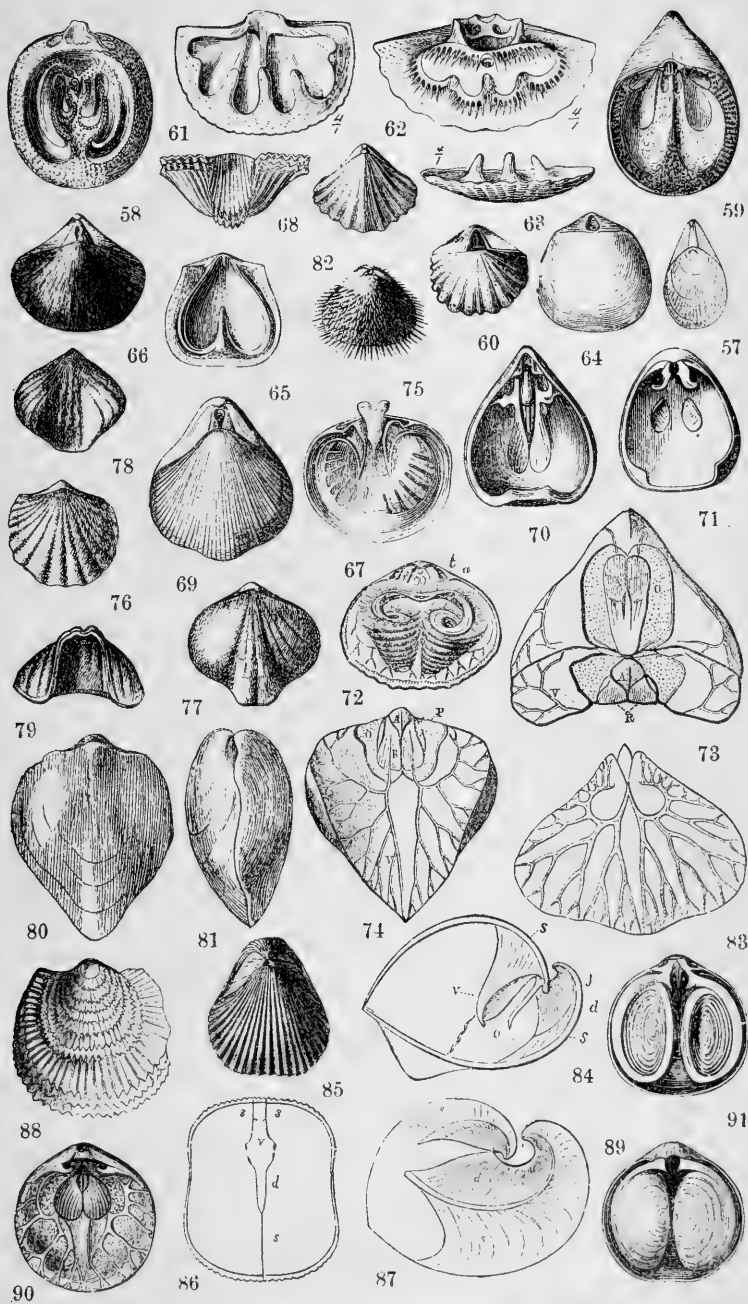


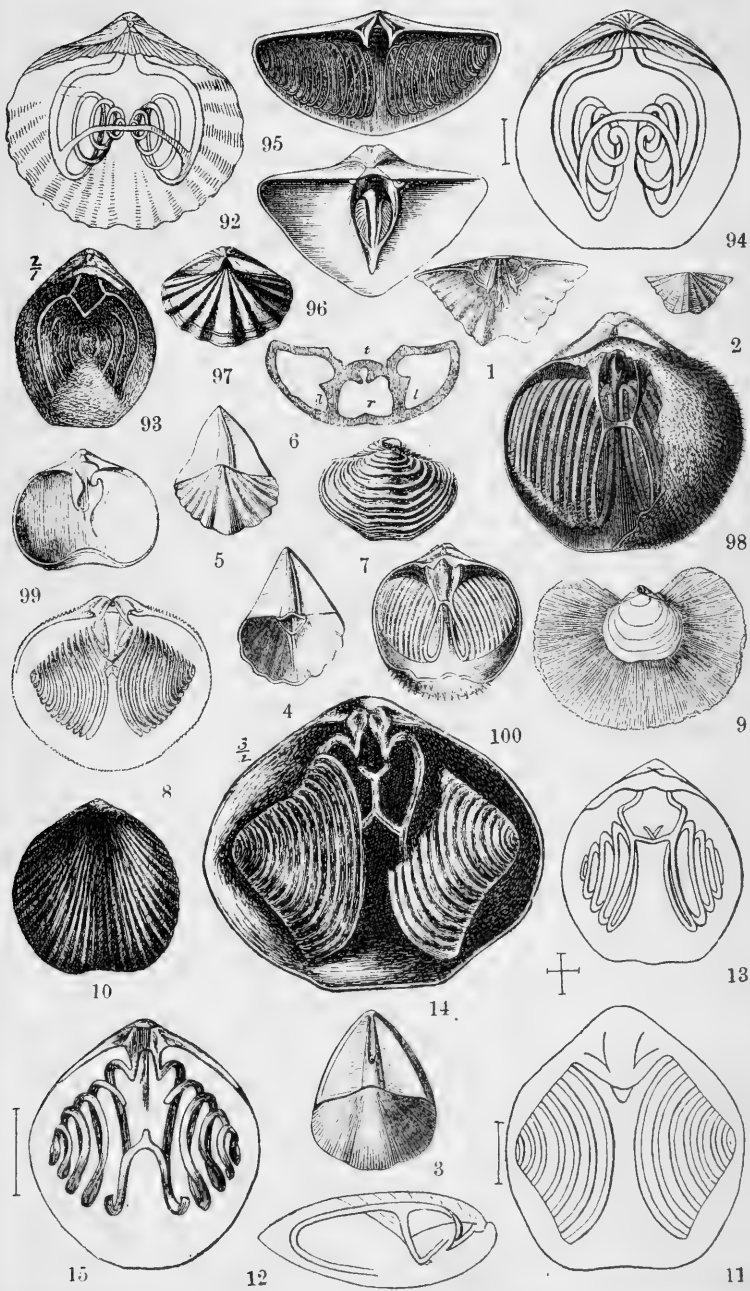


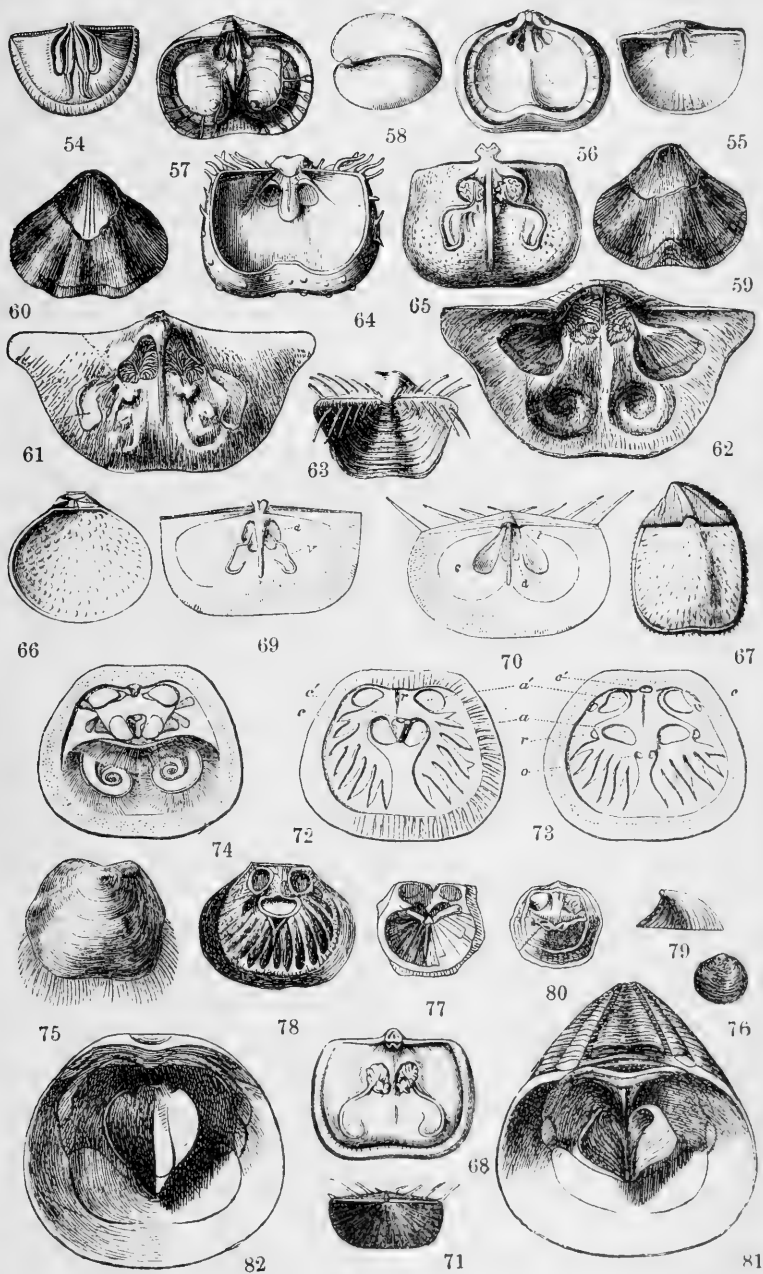


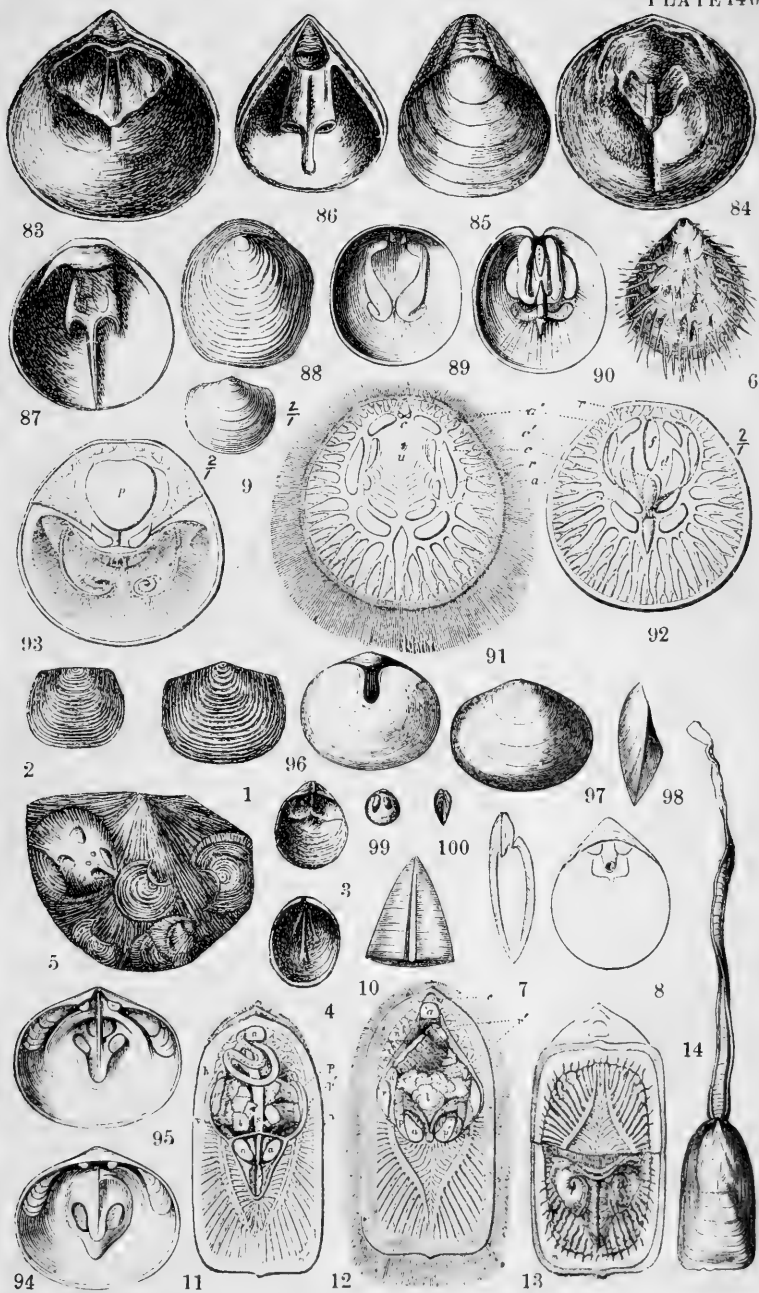












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